HP 3430A

OPERATING AND SERVICE MANUAL

DIGITAL VOLTMETER
3430A

HEWLETT hp PACKARD

HP 3430A

CERTIFICATION

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

WARRANTY AND ASSISTANCE

All Hewlett-Packard products are warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed in the operating manual, for the specified period. We will repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard. No other warranty is expressed or implied. We are not liable for consequential damages.

Service contracts or customer assistance agreements are available for Hewlett-Packard products that require maintenance and repair on-site.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

OPERATING AND SERVICE MANUAL

(HP PART NO. 03430-90002)

MODEL 3430A
DIGITAL VOLTMETER

Serials Prefixed: 943-

Appendix C, Manual Backdating Changes,
adapts manual to serials prefixed
641-, 723-, 749-, 933-.

SN° 1650G00541

P.O. Box 301, Loveland, Colorado, 80537 U.S.A.

Printed: SEPT 1969

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

Table 1-1. Specifications

VOLTMETER

Voltage Ranges: Full scale presentation of ±100.0 mV, 1000 mV, 10.00 V, 100.0 V and 1000 V (plus up to 60% overrange indicated with 4th digit). Maximum input is 1000 V. Range selection is manual, with automatic decimal point positioning. Polarity selection and indication are automatic.

Voltage Accuracy: ±(0.1% of reading + 1 digit) from 15°C to 35°C on all ranges. ±(0.25% of reading + 1 digit) from 0°C to 15°C and 35°C to 50°C on all ranges.

Stability: Rated accuracy is met after a 10 minute warm-up period. The voltage accuracy is guaranteed for three months. Zero stability is better than 25 μV/°C. Zero should be adjusted if the operating source resistance is > 100 kΩ on the 100.0 mV range.

Response Time: Input amplifier responds to 99.9% value of a step input in 0.5 seconds.

Input Resistance: 10 MΩ ±3.0% on all ranges.

Superimposed Noise Rejection: 40 dB at 60 Hz, increasing 12 dB/octave at higher frequencies.

Input Isolation: Floating; low side (middle terminal on the front panel) may be operated up to ±500 Vdc with respect to chassis ground (350 V rms).

Effective Common Mode Rejection: Ratio of common mode signal to resultant error in readout.

DC: > 90 dB on 100.0 mV range, decreasing 20 dB per range.

AC: > 90 dB on 100.0 mV range, decreasing 20 dB per range.

DC Amplifier Output: ±16 Vdc maximum into 16 kΩ minimum resistance for input of 60% overrange. ±10 Vdc maximum into 10 kΩ minimum resistance for full scale input. Non-inverting voltage gain, (3430A input to amplifier output), is 100 on the 100 mV Range, decreasing by a factor of 10 on each higher range. Gain accuracy: ±0.1% from 15°C to 35°C, ±0.15% from 0°C to 15°C and 35°C.

Sample Rate: Fixed, at 2 per second.

Power: 115 or 230 volts ±10%, 50 to 400 Hz, approximately 20 watts.

RATIO OPTION

Reference Input Range: 0.8 to 1.2 Vdc either polarity (selected at rear panel) for rated accuracy. Instrument is usable with reference voltage between 0.2 and 1.3 V.

Reference Input Resistance: 50 kΩ ±2% for positive reference, 511 kΩ ±2% for negative reference.

Front Terminal Input Range: 100.0 mV full scale nominal on lowest range to 1000 V maximum on highest range, either polarity, with automatic polarity indication.

Front Terminal Input Resistance: 10 MΩ ±3% on all ranges.

Ratio Accuracy: ±(0.15% of reading + 1 digit) 15°C to 35°C. ±(0.30% of reading + 1 digit) 0°C to 15°C and 35°C to 50°C.

Maximum Correct Indication: 1599 for reference inputs between 0.8 V and 1.0 V. 1333 for reference inputs between 1.0 V and 1.2 V.

GENERAL

Dimensions: 7-25/32 in. wide, 6-17/32 in. high, 12 in. deep (190 x 166 x 334 mm).

Weight: 9-3/4 lbs. (4.39 kg); Shipping: 12 lbs. (5.4 kg).

SECTION II
INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information and instructions necessary for the installation and shipping of the Model 3430A Digital Voltmeter. Included are initial inspection procedures, power and grounding requirements, installation information, and instructions for repackaging for shipment.

2-3. INITIAL INSPECTION.

2-4. This instrument was carefully inspected both mechanically and electrically before shipment. It should be physically free of mars or scratches and in perfect electrical order upon receipt. To confirm this, the instrument should be inspected for physical damage in transit. Also check for supplied accessories, and test the electrical performance of the instrument using the procedure outlined in Paragraph 5-5. If there is damage or deficiency, see the warranty on the inside front cover of this manual.

2-5. POWER REQUIREMENTS.

2-6. The Model 3430A can be operated from any source of 115 or 230 volts at 50 to 400 Hz. The 115/230 V slide switch on the rear panel selects the desired line voltage. Power dissipation is approximately 20 watts.

2-7. GROUNDING REQUIREMENTS.

2-8. To protect operating personnel, the National Electrical Manufacturers' Association (NEMA) recommends that the instrument panel and cabinet be grounded. This instrument is equipped with a three-conductor power cable which, when plugged into an appropriate receptacle, grounds the instrument. The offset pin on the power cable three-prong connector is the ground wire.

2-9. To preserve the protection feature when operating the instrument from a two-contact outlet, use a three-prong to two-prong adapter and connect the green pigtail on the adapter to ground.

2-10. INSTALLATION.

2-11. The Model 3430A is fully transistorized; therefore, no special cooling is required. However, the instrument should not be operated where the ambient temperature exceeds 50^oC (122^oF) or the relative humidity exceeds 95%.

2-12. BENCH MOUNTING.

2-13. The Model 3430A is shipped with plastic feet and tilt stand in place, ready for use as a bench instrument.

2-14. RACK MOUNTING.

2-15. The Model 3430A may be rack mounted by using an adapter frame (-hp- Part No. 5060-0797). The adapter frame is a rack frame that accepts any combination of submodular units. It can be rack mounted only. For additional information, address inquiries to your -hp- Sales and Service Office. (See Appendix B for office locations.)

2-16. COMBINATION MOUNTING.

2-17. The Model 3430A may be mounted in combination with other submodular units by using a Combining Case (-hp- Model 1051A or 1052A). The Combining Case is a full-module unit which accepts various combinations of submodular units. Being a full-module unit, it can be bench or rack mounted and is analogous to any full-module instrument.

2-18. REPACKAGING FOR SHIPMENT.

2-19. The following paragraphs contain a general guide for repackaging of the instrument for shipment. Refer to Paragraph 2-20 if the original container is to be used; 2-21 if it is not. If you have any questions, contact your local -hp- Sales and Service Office. (See Appendix B for office locations.)

NOTE

If the instrument is to be shipped to Hewlett-Packard for service or repair, attach a tag to the instrument identifying the owner and indicating the service or repair to be accomplished; include the model number of the instrument. In any correspondence, identify the instrument by model number, serial number, and serial number prefix.

2-20. If original container is to be used, proceed as follows:

a. Place instrument in original container if available. If original container is not available, a suitable container can be purchased from your nearest -hp- Sales and Service Office.

b. Ensure that container is well sealed with strong tape or metal bands.

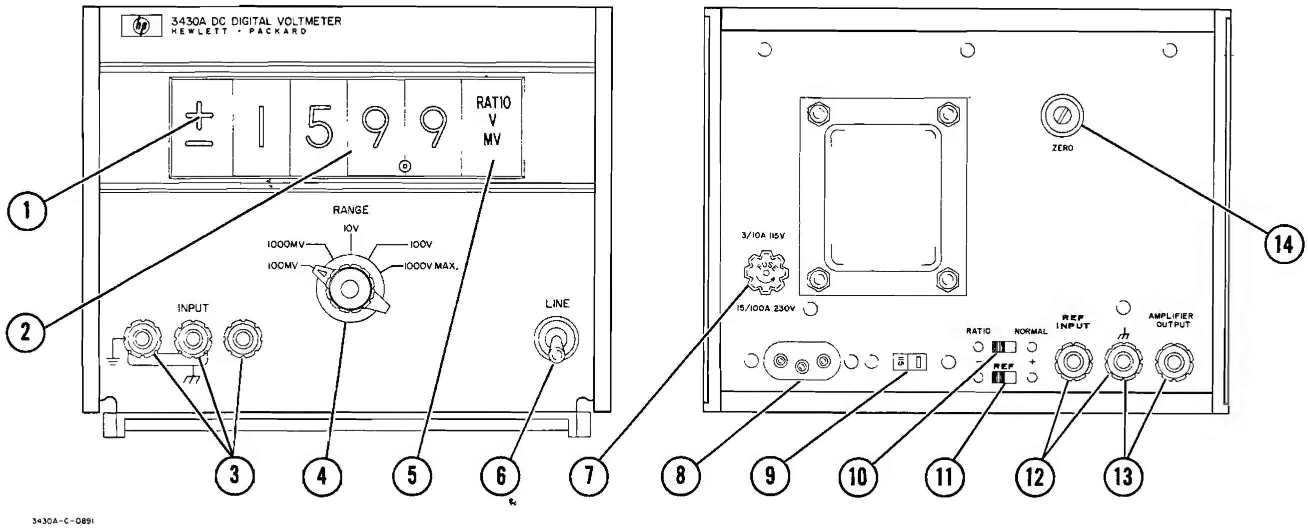
2-21. If original container is not to be used, proceed as follows:

a. Wrap instrument in heavy paper or plastic before placing in an inner container.

b. Place packing material around all sides of instrument and protect panel face with cardboard strips.

c. Place instrument and inner container in a heavy carton or wooden box and seal with strong tape or metal bands.

d. Mark shipping container with "DELICATE INSTRUMENT," "FRAGILE," etc.



1 .Polarity Indicator: Indicates input voltage polarity.

2 Illuminated Readout Display: Indicates magnitude of voltage and position of decimal point.

3 INPUT: Input voltage is applied between the High (red) and Common (⏊) terminals. A shorting bar provided with the instrument allows the input signal to be referenced to chassis ground when connected between the instrument common (⏊) and chassis ground (⏚) terminals.

4 RANGE Switch: Selects full scale input. Controls decimal point and multiplier indicator.

5 Multiplier Indicator: Indicates instrument measurement unit: (V or mV) and RATIO (Option 01 only).

6 LINE SWITCH: Applies primary power to instrument.

7 115/230 Volt Fuse: For 115 volt operation a 2/10 A. 125 V slow-blow fuse is used; for 230 volt operation a 15/100 A. 250 V slow-blow fuse is used.

8 AC Power Connector: Connects to the primary power cable supplied with the instrument.

9 115/230 Slide Switch (S3): Selects either 115 or 230 volt operation.

10 RATIO/NORMAL Switch (S4) (Option 01 only): Selects the Model 3430A function; NORMAL selects voltage measurements (see Paragraph 3-13); RATIO selects voltage ratio measurements.

11 + REF - Switch (S5) (Option 01 only): Selects polarity of ratio reference voltage (see Paragraph 3-13).

12 REF INPUT (Option 01 only): The ratio reference voltage is applied to these two terminals (see Paragraph 3-13).

13 AMPLIFIER OUTPUT: A 0 to ±15.99 volt dc output proportional to dc input.

14 ZERO Adjustment: Sets the digital readout on the front panel for zero indication when input is shorted, or for zero with a known source resistance (see Paragraph 3-5e, note).

Figure 3-1. Front and Rear Panel Description

SECTION III
OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. The -hp- Model 3430A Digital Voltmeter measures dc voltages from ±100 mV full scale to ±1000 V full scale with accuracy of ±(0.1% of reading + 1 count) and overrange capability of 60%. The Model 3430A also functions as a ±0.1% dc amplifier with 5 gain ranges from + 40 dB to - 40 dB. With Option 01, the Model 3430A measures dc voltage ratios from 0.0001 to 1000:1. This section describes the procedures for operating the Model 3430A as a voltmeter, ratiometer, and amplifier.

3-3. FRONT AND REAR PANEL DESCRIPTION.

3-4. Figure 3-1 shows the location of all the front and rear panel indicators and includes a brief description of each.

3-5. TURN-ON PROCEDURE.

a. Set the 115/230 slide switch (S3) to coincide with the line voltage used.

b. Connect power line to ac power connector. If instrument has Option 01, set RATIO/NORMAL switch to NORMAL position.

c. Switch LINE toggle switch upward, turning instrument on. Allow 10 minutes for instrument warmup.

d. Set the Model 3430A RANGE to 100 mV, and short input terminals.

e. Adjust rear panel ZERO control so that digital readout indicates all zeros and polarity indicator switches alternately between + and -.

NOTE

There may be a zero offset of a few counts between shorted input and open input on the 100 mV range. This is caused by a small leakage current flowing from the amplifier input through the input attenuator to ground. This offset does not affect the accuracy when measuring across a low source resistance (< 100 kΩ). However, when measuring across a source resistance greater than 100 kΩ, there may be a small error. This error can be eliminated by zeroing the Model 3430A with the source resistance connected across the input.

3-6. DC VOLTAGE MEASUREMENTS.

a. Turn Model 3430A on and zero it according to the steps in Paragraph 3-5.

b. Set RANGE switch to approximate range of input. If in doubt, select highest range, and downrange as necessary.

CAUTION

DO NOT APPLY VOLTAGE GREATER THAN 1000 V TO INPUT TERMINALS. DO NOT FLOAT ⊥ TERMINAL MORE THAN 500 V ABOVE GROUND (⏚).

c. Connect voltage to be measured to INPUT terminals. Connect high side of input to high (red) terminal and low side to ⊥ terminal. For floating measurement, disconnect shorting bar between ⊥ and ⏚ terminals. For a referenced measurement, leave shorting bar connected.

d. Read magnitude of applied voltage on front panel. Polarity is automatically indicated.

3-7. OVERRANGE OPERATION.

3-8. The Model 3430A can be operated with input signals 59.9% overrange on all ranges except the 1000 V range with no loss in accuracy. For example, 15.99 volts may be applied with the range switch in the 10 V position.

3-9. OVERLOAD INDICATION.

3-10. Any voltage in excess of 59.9% overrange will cause the Model 3430A to overload. This condition is indicated by a flashing display.

3-11. DC AMPLIFIER OPERATION.

3-12. The Model 3430A may be used as a dc amplifier with a ±0.1% gain accuracy. The gain depends on the range selection. The input is connected to the front panel INPUT terminals and the output is taken from the rear panel AMPLIFIER OUTPUT terminals. The dc amplifier output can also be used to drive a recorder while dc voltage measurements are being made.

a. Turn on and zero the Model 3430A according to Paragraph 3-5.

b. Select desired gain using RANGE switch. Table 3-1 shows the input voltage, output voltage, and gain for each RANGE selection.

Table 3-1. Amplifier Gain

Range	Input	Amplifier Output	Gain
100 mV	0 to ±159.9 mV	0 to ±15.99 V	40 dB
1000 mV	0 to ±1599 mV	0 to ±15.99 V	20 dB
10 V	0 to ±15.99 V	0 to ±15.99 V	0 dB
100 V	0 to ±159.9 V	0 to ±15.99 V	-20 dB
1000 V	0 to ±1000 V	0 to ±10.00 V	-40 dB

c. Connect the signal to be amplified to the INPUT terminals and the load to the AMPLIFIER OUTPUT terminals.

NOTE

The load resistance must be greater than 16kΩ or the amplifier gain accuracy will not be within ±0.1% and the amplifier will not have full dynamic range.

3-13. RATIO OPERATION (Option 01 only).

3-14. Instruments with Option 01 have the capability of measuring voltage ratios. The following steps describe the procedure.

a. Turn on and zero the 3430A according to Paragraph 3-5.

b. Slide NORMAL/RATIO switch to RATIO position. RATIO indicator will light.

c. Apply a dc reference voltage of 0.80 to 1.20 volts between rear panel REF INPUT and ⏊ terminals.

d. Slide REF POLARITY switch to coincide with polarity of reference voltage with respect to circuit common (⏊). If REF POLARITY switch is in incorrect position, front panel display will flash.

e. Set range switch to appropriate range of input. If in doubt, select highest range and downrange as necessary.

f. Connect input signal.

3-15. The front panel displays will indicate the ratio of the input voltage to the reference voltage. On the 10 V, 100 V, and 1000 V ranges the "V" indicator will be lit. On the 100 mV and 1000 mV ranges the "MV" indicator will be lit, indicating that the ratio must be divided by 1000. For example, a ratio reading of 608 on the 1000 mV range would actually be a ratio of 0.608.

3-16. The reference voltage applied to the rear terminals must be 0.8 to 1.2 volts for operation at rated accuracy. If the reference voltage is greater than 1.00 V the maximum readout of 1599 counts cannot be achieved, and the maximum number of counts is equal to $\frac{1599}{V_{reference}}$. When $V_{reference}$ is 1.2 volts, the maximum number of counts is 1333.

3-17. Usable ratio readings may be made with reference voltages as high as 1.3 volts or as low as 0.2 volts, but the accuracy is derated. Table 3-2 shows typical accuracies with reference voltages greater than 1.2 volts and less than 0.8 volts. The accuracy values are shown with equal reference and input voltages (ratio = 1.000).

Table 3-2. Typical Ratio Accuracy Variations

Reference Voltage	Accuracy
0.2 V	± (1.3% of reading + 1 count)
0.3 V	± (0.9% of reading + 1 count)
0.4 V	± (0.7% of reading + 1 count)
0.5 V	± (0.5% of reading + 1 count)
0.6 V	± (0.3% of reading + 1 count)
0.7 V	± (0.2% of reading + 1 count)
0.8 to 1.2 V	± (0.15% of reading + 1 count)
1.3 V	± (0.2% of reading + 1 count)

SECTION IV
THEORY OF OPERATION

4-1. GENERAL.

4-2. The Model 3430A makes voltage measurements by comparing the input voltage to an internally generated "staircase ramp" voltage. When the input and the staircase ramp voltages are equal, a comparator generates a signal to stop the ramp. Then the instrument displays the number of steps necessary to make the staircase ramp equal to the input. At the end of the sample, a reset pulse resets the staircase to zero and the measurement starts over. The display circuits store each reading until a new reading is completed, eliminating any blinking or counting during computation. The sample rate is fixed at two samples per second. Figure 4-1 shows the relationship between the staircase ramp and the input signal.

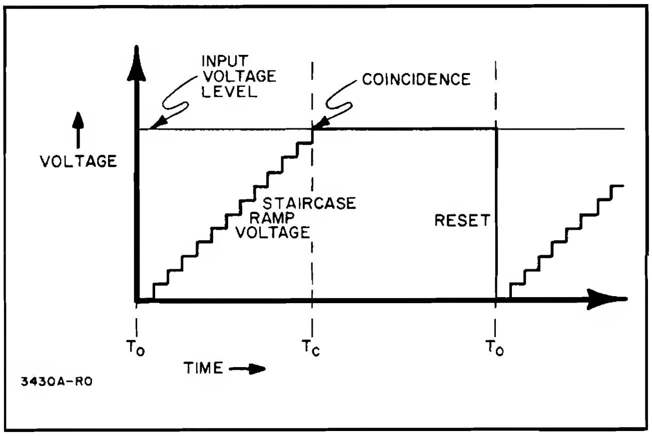


Figure 4-1. Relationship Between the Staircase Ramp and Input Signal

4-3. BLOCK DIAGRAM ANALYSIS. (Fig. 7-2)

4-4. The Staircase Ramp circuits include a 4.5 kHz oscillator, decade counter circuits, and digital-to-analog (D/A) converters. The counter circuit counts the pulses from the 4.5 kHz oscillator, and the output of the counter is a binary number equal to the total number of oscillator pulses. The D/A converters convert the binary numbers from the counter to equivalent analog voltages. Thus, each pulse from the oscillator causes one count increase in the counter output, making the D/A converter output increase by a fixed amount. As long as the oscillator continues to run, the converter output increases incrementally, producing a "staircase" ramp voltage. The staircase ramp from the D/A converter is applied to the Staircase Amplifier, the gain of the staircase amplifier is adjusted to calibrate the ramp. The comparator flip-flop controls the staircase ramp by turning the 4.5 kHz oscillator on and off.

4-5. The input signal passes through the input attenuator to the input amplifier where it is amplified by a factor of 100. The attenuator output is 0 to ± 100 mV full scale on all ranges, so the amplifier output is 0 to ±10 V full scale, and 0 to ±15.99 V with overrange. The rear panel AMPLIFIER OUTPUT is the output of the input amplifier.

4-6. The comparator input is a resistive summing junction. The staircase voltage is positive, so the input signal connected to the summing junction must be negative. The inverting amplifier and polarity switch assure a negative voltage to the comparator summing junction for either polarity input. If the input is positive, the inverting amplifier output is negative and the diode at its output is forward biased, applying this negative voltage to the summing junction. The negative voltage also turns off the polarity switch. If the input is negative, the inverting amplifier output will be positive and the diode will be reverse biased. At the same time, the polarity switch is turned on, allowing the negative input voltage to be applied to the summing junction.

4-7. The 2 Hz sample oscillator controls the sampling of the Model 3430A. Its output is a 100 ms timing pulse occurring two times per second. The timing pulse drives the transfer amplifier to produce the transfer pulse, and the trailing edge of the transfer pulse triggers the reset amplifier, producing the reset pulse. The transfer pulse transfers the number stored in the counters to the readout at the end of each sample. The reset pulse ends the measurement sample and initiates a new sample.

4-8. At T_o the reset pulse resets the decade counters to zero and sets the comparator flip-flop to allow the 4.5 kHz oscillator to run, starting the staircase ramp. The ramp increases until it equals the input. When the ramp and the input are equal (T_c) the comparator output changes the state of the comparator flip-flop, stopping the oscillator and the ramp. At T_t, about 400 ms from the start of the sample, the transfer pulse transfers the stored count from decade counters to the digital display tubes. The reset pulse occurs at the trailing edge of transfer pulse, initiating a new sample.

4-9. INPUT ATTENUATOR.

4-10. The input attenuator A6 (see Figure 7-8) is a series voltage divider with a total resistance of 10 MΩ. It provides five ranges from 100 mV full scale to 1000 V full scale, and its output is 0 to ±100 mV full scale on all ranges. With a 60% overrange input, the attenuator output is ±159.9 mV. A6R4, R6, R9 and R12 are adjusted to calibrate the attenuator. A6R3* is selected to adjust the total resistance. Resistors A6R1, R7, R10 and R13 set the attenuator's output resistance at 900 kΩ on all ranges.

4-11. INPUT AMPLIFIER AND INVERTER AMPLIFIER.

4-12. The input amplifier is a feedback-stabilized dc amplifier with a gain of 100. The input stage is a differential amplifier made up of two matched field-effect transistors (A1Q1A and A1Q1B) enclosed in the same container. R4 and A1R84 adjust the balance of the input stage and act as zero controls for the amplifier. A1R84 is a coarse zero adjustment, and R4 is a fine adjustment. A1Q2 supplies a constant current to the differential amplifier to ensure linearity and stability. The output of the first stage is connected to another differential amplifier (A1Q3 and A1Q4) and then to emitter follower stage A1Q5. The signal from the emitter of A1Q5 drives A1Q6, the output stage.

4-13. In a feedback amplifier such as the input amplifier, the overall gain is inversely proportional to the amount of feedback, and if the open-loop gain of the amplifier is quite high, the gain is equal to the reciprocal of the feedback ratio. For example, if half of the output were fed back, the feedback ratio would be 1/2, and the gain would be 2. In the Model 3430A input amplifier, the output from the collector of A1Q6 is fed back to the gate of A1Q1B as shown by the heavy dotted line in Figure 7-3. A1R6, A1R7 and A1R9 form a series voltage divider, and the voltage across A1R6 and 7 is applied to the gate of A1Q1B. Since the voltage across A1R6 and 7 is 1/100 of the total output, the gain is 100. A1R7 is adjusted to set the gain at exactly 100.

4-14. Superimposed ac signals on the amplifier output are shunted around A1R9 by A1C3 and A1R71. Consequently, more of the ac signal is fed back, reducing the ac gain and improving the ac rejection of the amplifier. A pi type input filter (A1R2, A1C1 and A1C2) provides additional ac noise rejection.

4-15. The inverter amplifier is a unity gain operational amplifier. In this type of amplifier, the inverted output is fed back to the input for gain stabilization, and the gain is equal to the ratio of the feedback resistance to the input resistance. The input resistance (A1R15) and the feedback resistance (A1R14 and A1R16) are equal, so the gain is one. A1R14 is selected to set the gain at exactly one.

4-16. POLARITY CIRCUITS.

4-17. A positive input voltage causes the inverting amplifier output to the polarity flip-flop to be negative, which sets the flip-flop to the state which turns on the + indicator. If the input voltage is negative, the polarity amplifier output is positive, turning on the - indicator.

4-18. The diode at the output of the inverting amplifier is included in the amplifier feedback loop. When the amplifier output is positive, the diode is reverse biased, opening the feedback loop and resulting in a high gain. Consequently, a small negative input voltage results in a sufficiently large positive voltage at the amplifier output to turn on the polarity switch and set the polarity flip-flop to the proper state.

4-19. COMPARATOR CIRCUITS.

4-20. The comparator is a high gain amplifier that compares the staircase with the input voltage. The input stage, A1Q13A and A1Q13B, is a differential amplifier. The staircase is applied through A1R31 to the base of A1Q13A, and the input voltage is applied through A1R30 to the base of A1Q13A. The staircase voltage is positive, and the input is negative. Before coincidence the voltage at the base of A1Q13A is negative, and as the staircase approaches the input the base voltage approaches zero. When the staircase becomes just slightly larger than the input, the base of A1Q13A becomes slightly positive; and the comparator saturates, triggering the comparator flip-flop.

4-21. The comparator flip-flop (A1Q16 and A1Q17) is a bistable circuit that controls the 4.5 kHz oscillator. At T_O, A1Q16 is cut off and A1Q17 is on, starting the 4.5 kHz oscillator. At T_C, the negative output from the comparator turns on A1Q16, changing the state of the comparator flip-flop. The negative output from the collector of A1Q17 stops the 4.5 kHz oscillator. At T_O, the reset pulse resets the comparator flip-flop to its original state.

4-22. 4.5 KHZ OSCILLATOR AND COUNT GATE.

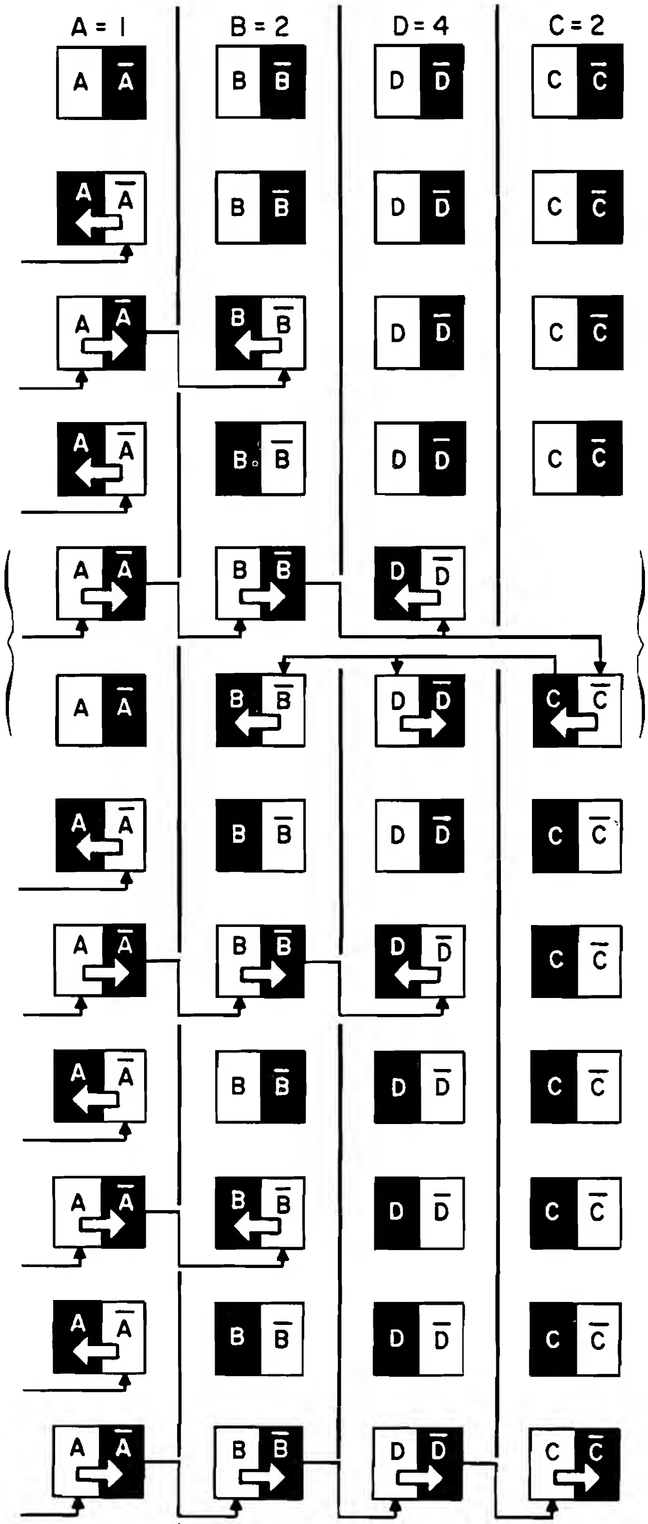
4-23. The 4.5 kHz oscillator is a relaxation oscillator. A1R27, A1R28, and A1R29 form a voltage divider, and the voltage across A1R29 is about -10 V, keeping A1Q8 and A1Q9 cut off. Capacitor A1C8 charges toward -30 V, and when its charge reaches about 11 volts, A1Q8 and A1Q9 turn on, discharging A1C8. When A1C8 is discharged, A1Q8 and A1Q9 are again reverse biased and A1C8 begins to recharge toward -30 V. This cycle continues, resulting in a 4.5 kHz non-symmetrical square wave at the collector of A1Q8. The frequency of oscillation is primarily determined by the RC time constant of A1C8 and A1R26.

4-24. The count gate, A1Q7, controls the 4.5 kHz oscillator. When A1Q7 is on, it shorts A1C8, preventing the oscillator from operating. When A1Q7 is cut off, it has no effect on the oscillator. At T_C, the negative output from A1Q7 in the comparator flip-flop turns A1Q7 on, stopping the oscillator.

4-25. DECADE COUNTER CIRCUITS.

4-26. The decade counters count the pulses from the 4.5 kHz oscillator and generate a binary coded decimal number equal to the total number of pulses. Figure 4-2 shows a block diagram of a typical decade counter. The counters each contain four binaries connected in series. Each binary is a bistable multivibrator connected to change state with each input pulse. Binary A will change state with each pulse from the oscillator; binaries B through D will follow the switching sequence shown in Table 4-1. Each input pulse will cause a unique combination of outputs. There are ten such combinations and each one represents a decimal digit.

Table 4-1. Counter Switching Sequence

DECIMAL COUNT	COUNTER STATE (■ CONDUCTION)	4-LINE CODE			
	WEIGHTING: A = 1, B = 2, D = 4, C = 2	D	C	B	A
0		0	0	0	0
1		0	0	0	1
2		0	0	1	0
3		0	0	1	1
4		0	1	1	0
5		0	1	1	1
6		1	1	0	0
7		1	1	0	1
8		1	1	1	0
9		1	1	1	1
0		0	0	0	0

05212-C-1

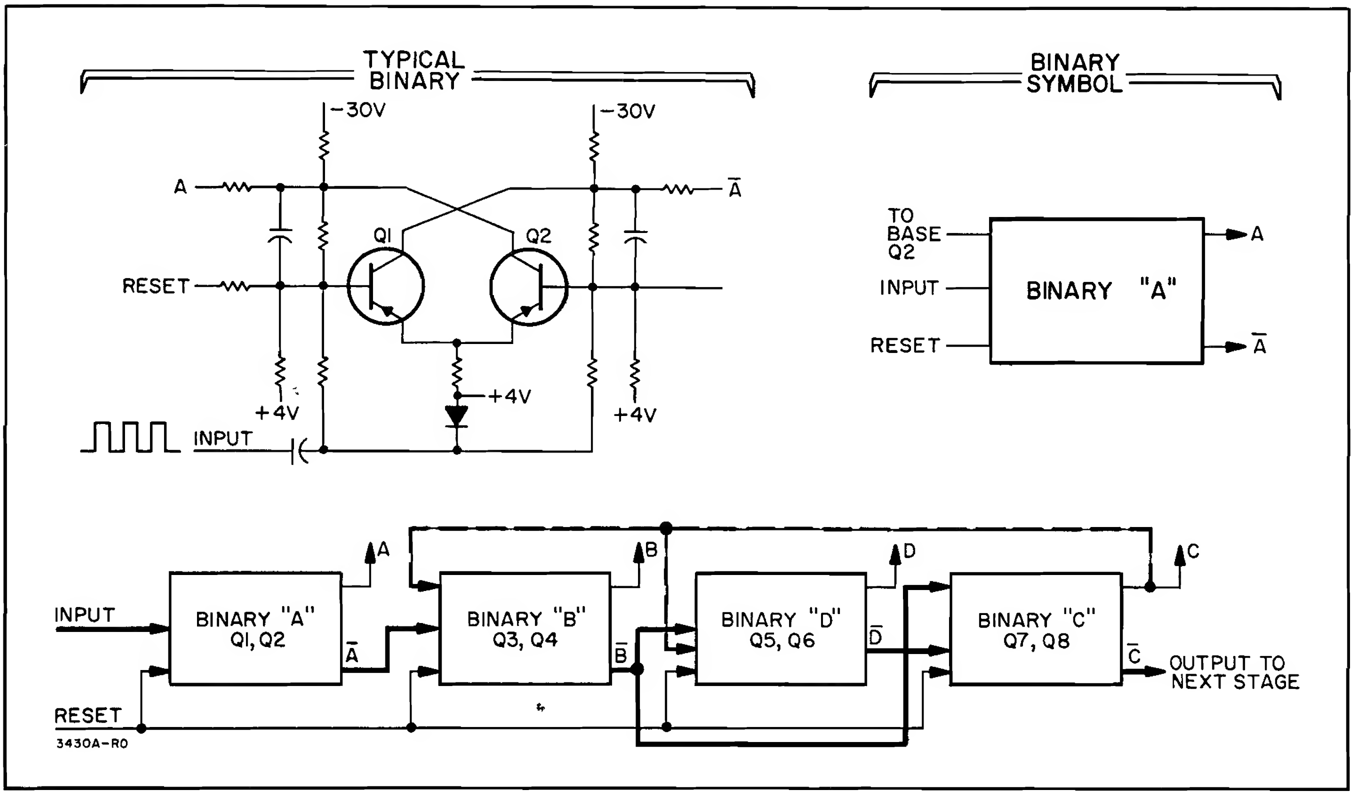


Figure 4-2. Decade Counter Circuit

4-27. A given binary, A for example, has two states, A and $\overline{A}$. (See typical binary in Figure 4-2.) When the A transistor is conducting the binary is in the A state, and when the $\overline{A}$ transistor is conducting the binary is in the $\overline{A}$ state. A is called the "true" state and $\overline{A}$ the "false" state.

4-28. A true binary represents a decimal number. (A = 1, B = 2, C = 2, and D = 4.) A false binary represents zero. The decimal number represented by the decade counter is the sum of the numbers represented by each binary. For example, if binary A is true, B is true, D is false, and C is true; the number represented is 1 + 2 + 0 + 2 = 5.

4-29. Table 4-1 shows the counting sequence. The arrow in each block shows the direction the binary has switched. Initially each binary is set to the false state by the reset pulse (DCBA = 0000). The following action takes place when a series of pulses is applied to the counter:

a. The first pulse switches A to the "1" (true) state.

b. The second pulse switches A to the "0" (false) state, and the output from A switches to B to the "1" (true) state. (DCBA = 0010 = 2.)

c. The third pulse switches A to the "1" state. (DCBA = 0011 = 3.)

d. The fourth pulse switches A to the "0" state; the output from $\overline{A}$ changes B to the "0" state; the output from $\overline{B}$ changes D and C to the "1" state. The resulting signal from C is applied to $\overline{B}$ and D to return B to the "1" state and D to the "0" state. Although $\overline{D}$ is connected to C, no switching occurs at C because C has not recovered from its recent switching. (DCBA = 0110 = 4.)

e. The fifth pulse switches A to the "1" state. (DCBA = 0111 = 5.)

f. The sixth pulse switches A to the "0" state; the output from $\overline{A}$ switches B to the "0" state; the output from $\overline{B}$ switches D to the "1" state. (DCBA = 1100 = 6.)

g. The seventh pulse switches A to the "1" state. (DCBA = 1101 = 7.)

h. The eighth pulse switches A to the "0" state; the output from $\overline{A}$ switches B to the "1" state. (DCBA = 1110 = 8.)

i. The ninth pulse switches A to the "1" state. (DCBA = 1111 = 9.)

j. The tenth pulse switches A to the "0" state; the output from $\overline{A}$ switches B to the "0" state; the output from $\overline{B}$ switches D to the "0" state; the output from $\overline{D}$ switches C to the "0" state; (DCBA = 0000.) When C becomes "0", C produces an output pulse which serves as a carry pulse to the next counter. The counter is now in its original state.

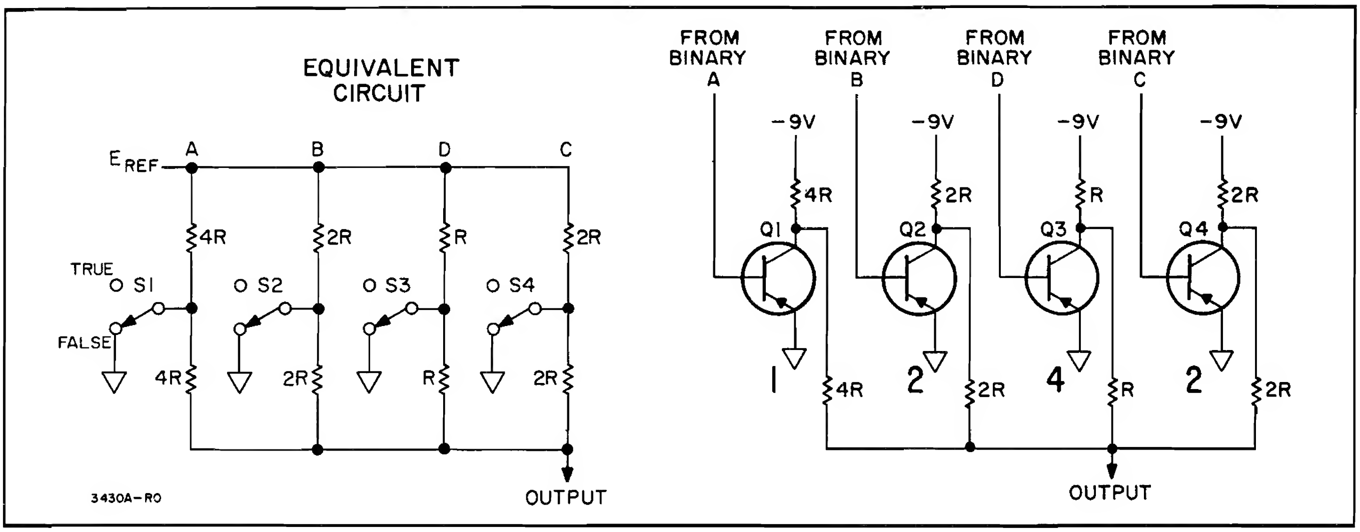


Figure 4-3. D/A Converter Circuit

4-30. D/A CONVERTERS.

4-31. The D/A converters convert the binary numbers represented by the counters to an equivalent current. Thus, each pulse into the counters causes the number represented to increase by one, and causes the current out of the converters to increase by one increment. The staircase amplifier converts the current from D/A converters to a proportional voltage, producing the staircase ramp.

4-32. Figure 4-3 contains an equivalent circuit of a D/A converter. Switches S1 through S4 are operated by binaries A, B, D, and C respectively. When the binaries are false, the switches are switched to ground as shown; when the binaries are true, they are switched to the opposite position. When binary A is true, current flows from E ref to the output through circuit A. This current is equivalent to a 1 in the counter. When binary B is true, current flows through circuit B to the output. The current through circuit B is twice as much as the current through circuit A, and this current represents a 2. When D is true, four times as much current flows to the output, representing a 4. When C is true, the current output represents a 2. The current output from the D/A will be proportional to the number in the counter.

4-33. Also shown in Figure 4-3 is the circuit used in the units and tens D/A converters. The switches are replaced by switching transistors. A false output from binary A would turn Q1 on, clamping its collector to ground. A true output would keep Q1 cut off, allowing a current path from the -9 V reference through the two 4R resistors to the output. This current represents a 1. Transistors Q2 through Q4 are controlled by binaries B, D, and C respectively.

4-34. The hundreds D/A circuits operate in a similar manner; however, the transistor switches operate in the inverted mode. That is, the transistor is turned on by the bias on the base-collector junction, rather than the base-emitter junction. When operated in the inverted mode, the switching resistance of the transistor is very low. This is necessary in the hundreds D/A circuits so that switching resistance does not affect the D/A output current. Figure 4-4a shows a typical D/A converter circuit when the associated binary is in the false state. Both the base-emitter and base-collector junctions of Q1 are reverse biased, so Q1 is off. The base-collector junction of Q2 is forward biased, so Q2 is turned on. The switching current, I_{SW}, flows through R_B and Q2 to ground. Since the output to the staircase amplifier is at a virtual ground (operational amplifier input), and because $R_{D/A}$ is a relatively high value, the current through $R_{D/A}$ to the staircase amplifier will be insignificant.

4-35. Figure 4-4b shows conditions when the binary is in the true state. Both junctions of Q2 are now reversed biased, so Q2 is turned off. The base-collector junction of Q1 is now forward biased, turning Q1 on. The switching current now flows from the -9 V reference supply through Q1 and R_B, which could cause excessive loading of the reference supply. Q3 is on at the same time Q1 is on, thus providing a source of compensating current to offset the switching current. Since I_{SW} is approximately three times as much as the D/A current $I_{D/A}$, the sum of the compensating current, I_{COMP}, and $I_{D/A}$ should equal I_{SW}.

4-36. To provide the 60% overranging capability of the 3430A, an overrange binary has been included in the hundreds decade counter (see Figure 7-4). When binary C changes from true to false, overrange binary E changes to the true state. This changes the state of the overrange flip-flop, lighting DS8, which is the overrange "1" indicator in the front panel display. Binary E, in the true state, also turns on its associated D/A circuit, and is coupled to the binary D D/A circuit, holding this circuit on, but allowing the binary and readout to reset to zero. Since the binary D D/A current has a weight of 4, and the binary E D/A current has a weight of 6, this provides an output of 10 from the hundreds decade to the staircase amplifier. Because the binary D D/A circuit is held on by the overrange binary, the hundreds decade may now count only five additional counts. This allows a maximum front panel reading of 1599.

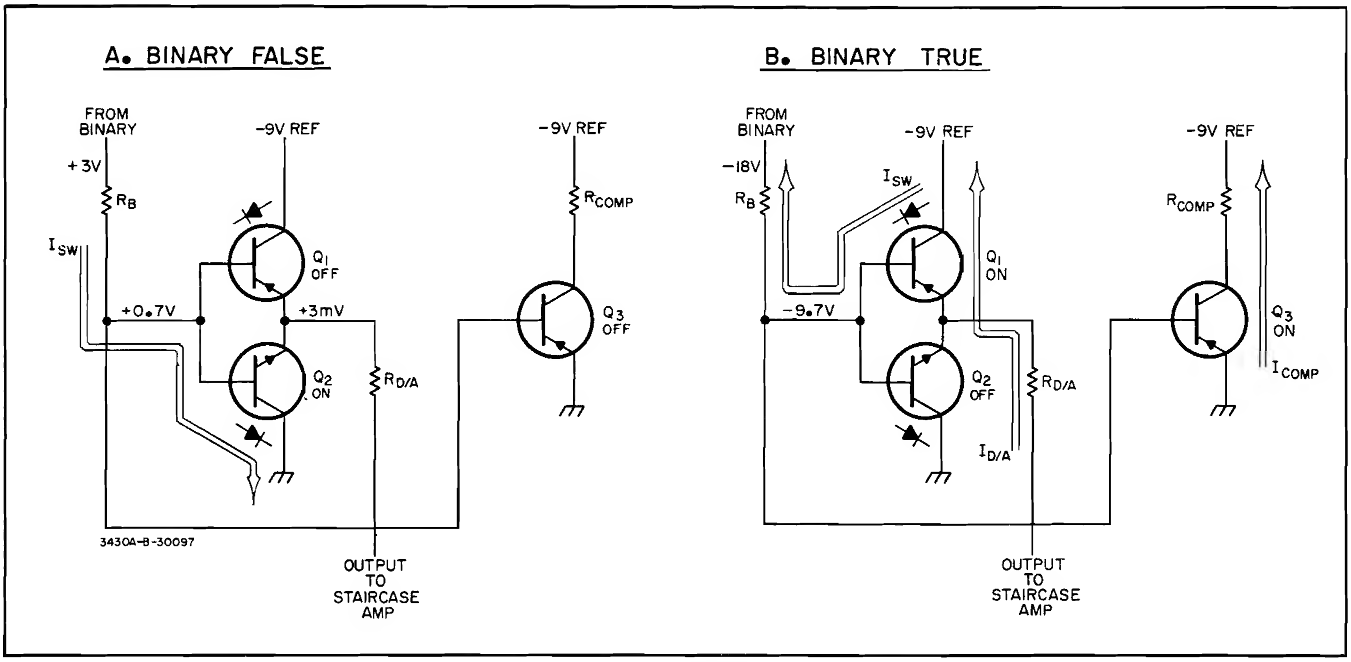


Figure 4-4. Typical Hundreds Decade D/A Circuit

4-37. STAIRCASE AMPLIFIER.

4-38. The Staircase Amplifier converts the current from the D/A converters to a proportional voltage, producing the staircase ramp. It is an operational amplifier similar to the inverter amplifier. Its gain is adjusted by A1R51 so that a full scale staircase current will produce a + 10.000 volt output. A1R50* in the feedback circuit is selected to bring the gain adjustment into the range of A1R51.

4-39. DISPLAY AND STORAGE CIRCUITS.

4-40. The binary coded outputs of the counters control neon lamps. The lamps activate a photoconductor matrix which is connected to the display tube. A lighted photoconductor element has a resistance of about 20,000 ohms, and an unlighted element has a resistance of several megohms. Each binary coded decimal output yields a unique low resistance path through the matrix. There are ten such paths, and each is connected to a digit in the display tube.

4-41. Two lamps are connected to each binary, one to each collector. The lamp in the conducting collector is lit, and the one in the non-conducting collector is extinguished (see Figure 4-5a). Ordinarily, the lamps would reverse every time the binary switched, and the readout would flicker during the counting and resetting process. However, two diodes are connected between the lamps so that the lamps can only change state when the diodes are properly biased (see Figure 4-5b). This prevents flickering in the readout.

4-42. First consider the circuit without the diodes connected (Figure 4-5a). Lamp A is lighted, and lamp $\overline{A}$ is dark. Since transistor A is not conducting, the voltage across lamp A is established by both the circuit of conducting lamp A and the collector voltage of transistor $\overline{A}$. This voltage is typically 38 V, much lower than the lamp's firing potential of 70 V. So lamp $\overline{A}$ cannot fire.

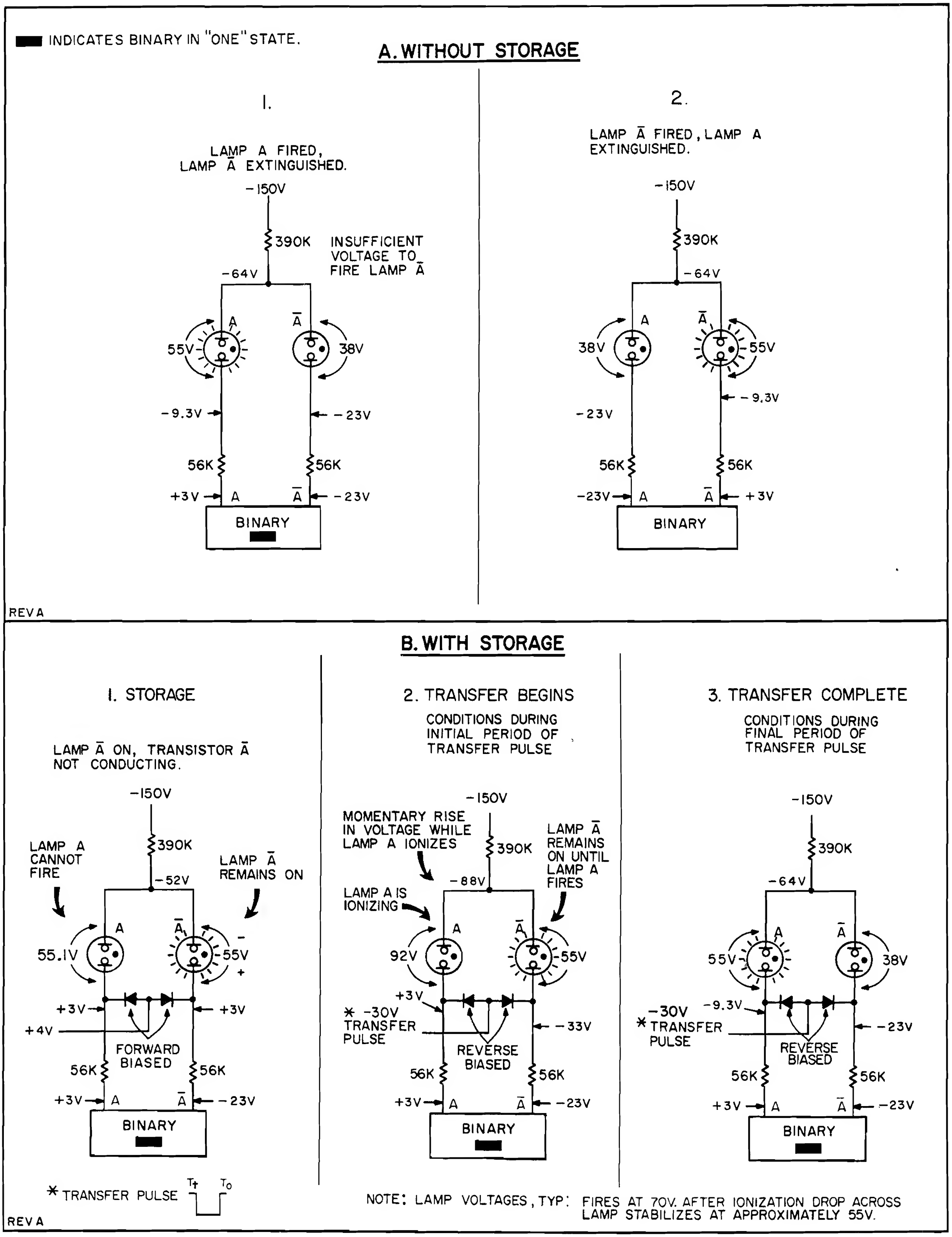
4-43. When the binary changes state, the transistor $\overline{A}$ collector voltage drops to - 1 volt, and the collector of transistor A rises to - 23 volts. When transistor A cut off, the voltage at the junction of the two lamps increases to about 70 volts and lamp $\overline{A}$ fires. Lamp A has - 23 volts on one side and - 70 volts on the other, and is extinguished.

4-44. When the diodes are connected as shown in Figure 4-5b, the switching of the lamps can be stopped. With +4 volts applied, both diodes are forward biased, clamping the bottom side of both neons to +4 volts. The voltage across the extinguished neon is now held at the sustaining voltage of the lighted neon, and the lamps cannot change state.

4-45. At T_t, the - 30 volt transfer pulse is applied to the diodes, reverse biasing them. The diodes are now effectively removed from the circuit and the lamps change to the state of the binary. At T_o, the transfer pulse is removed, and the lamps remain in that state until a new reading is transferred.

4-46. TIMING CIRCUITS.

4-47. The 2 Hz oscillator is a relaxation oscillator similar to the 4.5 kHz oscillator. Its output is a 2 Hz, negative going, 100 ms pulse that is applied to the base of A1Q28, the transfer amplifier. The output from the emitter of A1Q28 is the transfer pulse shown in Figure 7-2. The transfer pulse goes to the decade counter assemblies and is also applied to the reset amplifier. A1C13, A1R78, and A1R79 in the base circuit of A1Q29 differentiate the transfer pulse. The spike from the leading edge does not affect A1Q29, but the positive spike from the trailing edge turns on



INDICATES BINARY IN "ONE" STATE.
A. WITHOUT STORAGE
1.
LAMP A FIRED, LAMP Ā EXTINGUISHED.
-150V
390K
INSUFFICIENT VOLTAGE TO FIRE LAMP Ā
-64V
A
Ā
55V
38V
-9.3V
-23V
56K
56K
+3V
-23V
BINARY
2.
LAMP Ā FIRED, LAMP A EXTINGUISHED.
-150V
390K
-64V
38V
55V
-9.3V
-23V
56K
56K
-23V
+3V
BINARY
REV A
B. WITH STORAGE
1. STORAGE
LAMP Ā ON, TRANSISTOR Ā NOT CONDUCTING.
-150V
390K
LAMP A CANNOT FIRE
LAMP Ā REMAINS ON
-52V
55.1V
55V
+3V
+3V
+4V
FORWARD BIASED
56K
56K
+3V
-23V
BINARY
2. TRANSFER BEGINS
CONDITIONS DURING INITIAL PERIOD OF TRANSFER PULSE
-150V
MOMENTARY RISE IN VOLTAGE WHILE LAMP A IONIZES
390K
LAMP Ā REMAINS ON UNTIL LAMP A FIRES
-88V
LAMP A IS IONIZING
92V
55V
+3V
* -30V TRANSFER PULSE
-33V
REVERSE BIASED
56K
56K
+3V
-23V
BINARY
3. TRANSFER COMPLETE
CONDITIONS DURING FINAL PERIOD OF TRANSFER PULSE
-150V
390K
-64V
55V
38V
-9.3V
-30V
* TRANSFER PULSE
-23V
REVERSE BIASED
56K
56K
+3V
-23V
BINARY
* TRANSFER PULSE
T_t
T_0
NOTE: LAMP VOLTAGES, TYP: FIRES AT 70V. AFTER IONIZATION DROP ACROSS LAMP STABILIZES AT APPROXIMATELY 55V.
REV A

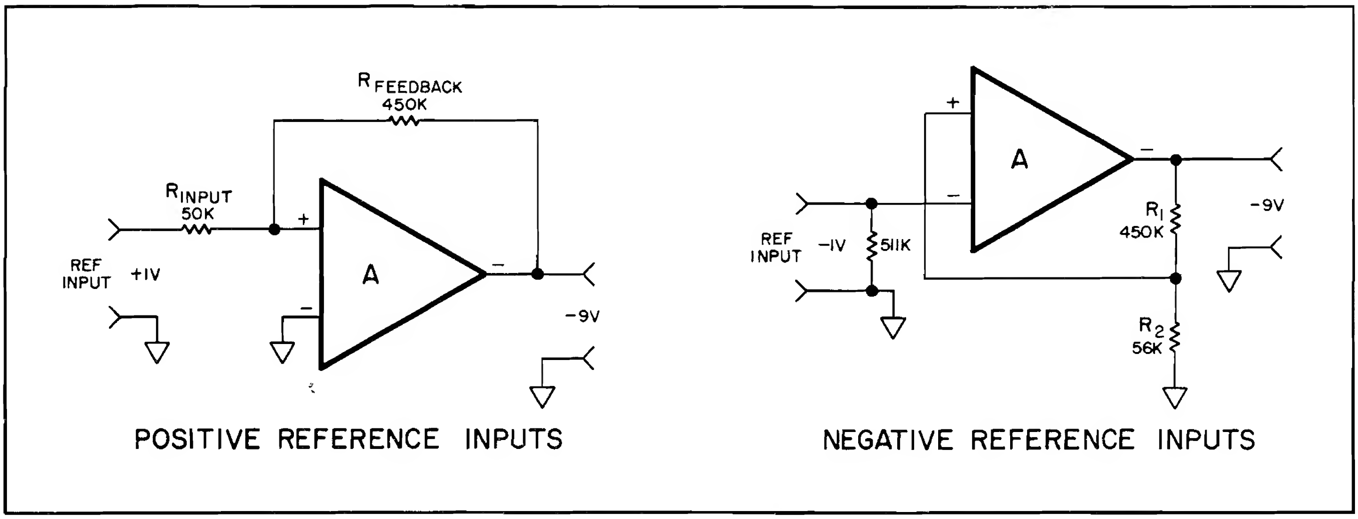


Figure 4-6. Ratio Reference Amp

A1Q29 to generate the reset pulse. Thus, the reset pulse occurs at the trailing edge of the transfer pulse, the end of the sample.

4-48. RATIO OPTION.

4-49. In the ratio mode of operation, the output of the reference amplifier replaces the internal - 9 V reference to the D/A circuits. Figure 4-6 shows simplified diagrams of the reference amplifier for positive and negative reference inputs. When a positive reference input is used, the reference amplifier is connected as an inverting operational amplifier with a gain of 9, where

$$\text{Gain} = \frac{R_{\text{feedback}}}{R_{\text{input}}}$$

When the reference input is negative, the reference amplifier is used as a non-inverting voltage amplifier, also having a gain of 9, where Gain = R1 + R2/R2. The front panel display will indicate the ratio of the input voltage to the reference voltage.

Table 5-1. Test Equipment Required

INSTRUMENT TYPE	REQUIRED CHARACTERISTICS	RECOMMENDED MODEL
DC Standard	Voltage Range: 0 - 1000 volts Accuracy: ±0.02% of setting ±10 μV	-hp- Model 741B AC/DC Differential Voltmeter/ DC Standard
DC Voltmeter	Range: 0 - 1000 V Accuracy: ±0.01% or better	-hp- Model 3420A/B Differential Voltmeter/ Ratiometer or -hp- Model 3460A Digital Voltmeter
DC Voltmeter	Range: 0 - 300 V Accuracy: ±2%	-hp- Model 427A Voltmeter
Oscilloscope	Bandwidth: to 450 kHz Sensitivity: 10 mV/cm	-hp- Model 120B Oscilloscope
Variable Transformer	Output Voltage: 103 to 127 Vac (or 207 to 253 Vac)	Superior Electric Co. Powerstat 3PF116 (for 115 V line) 3PF216 (for 230 V line)
Capacitor	0.82 μF ±10% mylar	-hp- Part No. 0160-0321
Resistor	1.0 MΩ ±0.1% 1/8 W	-hp- Part No. 0811-0473
Resistor	400 kΩ ±0.02% 1/8 W	Use four -hp- Part No. 0811-0191, 100 kΩ resistors
Resistor	33 kΩ ±10% 1/4 W	-hp- Part No. 0684-3331
Resistor	600 Ω ±1% 1/4 W	-hp- Part No. 0698-5405 -hp- Part No. 5060-0630
Oscillator	Frequency Range: 100 Hz Output: > 10 V rms	-hp- Model 200 CD Wide Range Oscillator
AC Voltmeter	Range: 0 - 10 V Frequency Range: 0 - 100 Hz Accuracy: ±3%	-hp- Model 403A AC Transistor Voltmeter

SECTION V
MAINTENANCE

5-1. INTRODUCTION.

5-2. This section contains information necessary to maintain the Model 3430A. The following paragraphs describe the Performance Checks, the Calibration Procedures and the Troubleshooting Procedures.

5-3. REQUIRED TEST EQUIPMENT.

5-4. Recommended test equipment for maintaining and checking performance of the Model 3430A is listed in Table 5-1. Test instruments other than those listed may be used if their specifications equal or exceed the required characteristics.

5-5. PERFORMANCE CHECKS.

5-6. Use the following front and rear panel procedures to verify proper operation of the Model 3430A. The Model 3430A and test equipment should be operated at 115/230 Vac unless otherwise specified. A Performance Check Test Card is provided at the end of this section for recording the performance of the 3430A. The card can be removed from the manual and used as a permanent record of the incoming inspection or of a routine performance check. If the Model 3430A is found to be out of specifications at any point in this procedure, refer to Paragraph 5-15, Adjustment and Calibration procedure.

5-7. ACCURACY CHECK.

a. Connect the Model 3430A to a variable line transformer.

b. Set line voltage switch to 115 or 230 Vac, and turn the 3430A on with the line switch.

c. Allow the 3430A to warm up for at least 10 minutes.

d. Short the INPUT terminals, and set RANGE switch to 10 V.

e. Adjust the rear panel ZERO control for a front panel indication of 0.00 V. Optimum adjustment is indicated by alternate flashing of (+) and (-) indicators.

f. Remove shorting connection from input.

g. Connect the standard as shown in Figure 5-1, and set the dc standard output to 1.000 volts. The 3430A indication should be between 0.99 V and 1.01 V.

h. Repeat step g for the values shown in Table 5-2. Then repeat the entire test on the 100 mV, 1000 mV, 100 V, and 1000 V ranges. The values shown in Table 5-2 may be used on the 100 mV, 1000 mV, 100 V and 1000 V test by moving the decimal point 1 or 2 places to the right or left. For the 1000 V test, do not exceed 1000 V input.

i. Repeat step h with negative voltages up to 500, removing input grounding strap on 3430A. Do not apply negative voltages greater than - 500 volts.

j. Repeat steps h and i with line voltages of 103 and 127 Vac (207 and 253 Vac with 230 Vac operation).

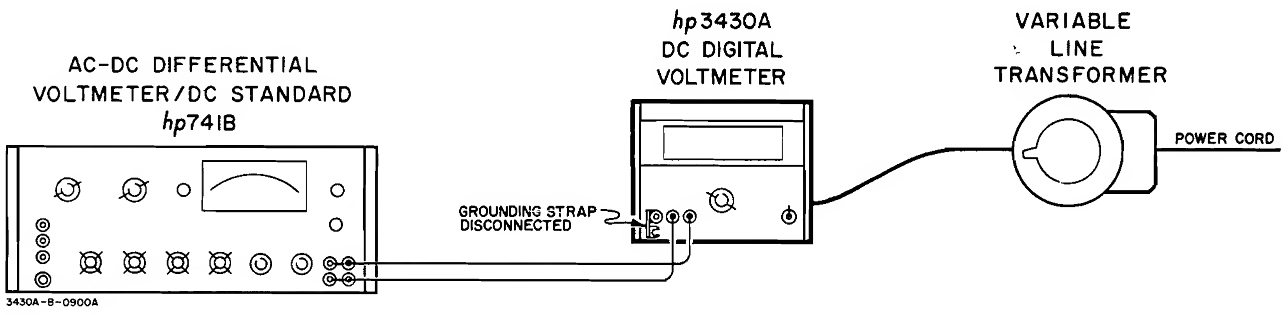


Figure 5-1. Accuracy Check

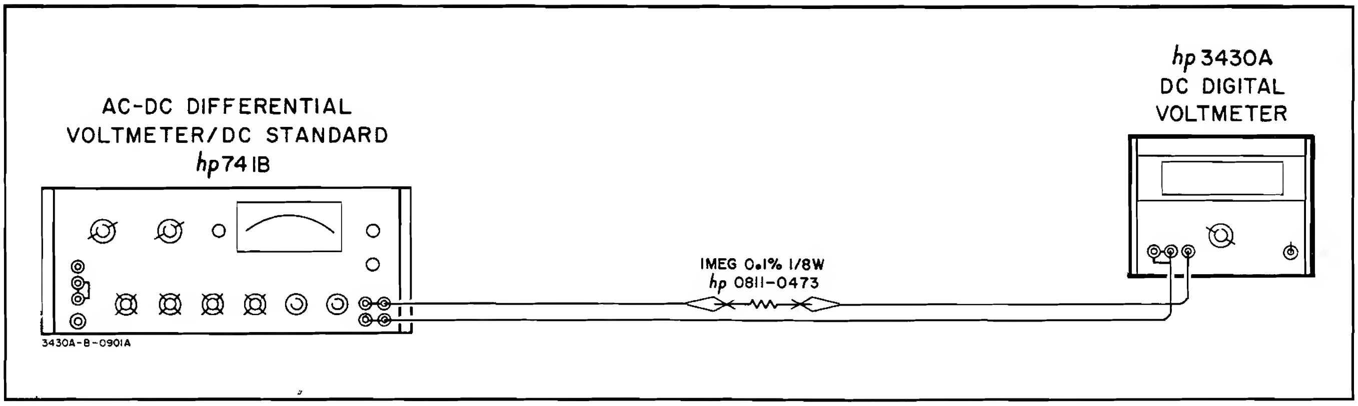


Figure 5-2. Input Resistance Check

Table 5-2. Calibration

	Model 3430A	
DC STANDARD	MINIMUM	MAXIMUM
0.00	- 0.01	+ 0.01
+ 1.00	+ 0.99	+ 1.01
+ 2.00	+ 1.99	+ 2.01
+ 3.00	+ 2.99	+ 3.01
+ 4.00	+ 3.99	+ 4.01
+ 5.00	+ 4.98	+ 5.02
+ 6.00	+ 5.98	+ 6.02
+ 7.00	+ 6.98	+ 7.02
+ 8.00	+ 7.98	+ 8.02
+ 9.00	+ 8.98	+ 9.02
+ 10.00	+ 9.98	+ 10.02
+ 11.00	+ 10.98	+ 11.02
+ 12.00	+ 11.98	+ 12.02
+ 13.00	+ 12.98	+ 13.02
+ 14.00	+ 13.98	+ 14.02
+ 15.00	+ 14.97	+ 15.02
+ 15.90	+ 15.87	+ 15.93

5-8. INPUT RESISTANCE CHECK.

a. Connect 3430A as shown in Figure 5-2. The 1 MΩ resistor (-hp- Part No. 0811-0473) and the 3430A input resistance form a series voltage divider.

b. Set RANGE switch to 10 V.

c. Set dc standard output to 10.00 volts.

d. The 3430A readout should indicate between 9.05 and 9.12. This corresponds to an input resistance of 9.7 to 10.3 MΩ where

$$R_{input} = \frac{E_{displayed}}{E_{input} - E_{displayed}} R_{series}$$

R_{series} is 1 MΩ in this test.

5-9. OVERLOAD INDICATION CHECK.

a. Connect the dc standard (-hp- Model 741B) to the 3430A INPUT.

b. Set the 3430A RANGE to 10 V. Set the dc standard to 15.0 volts.

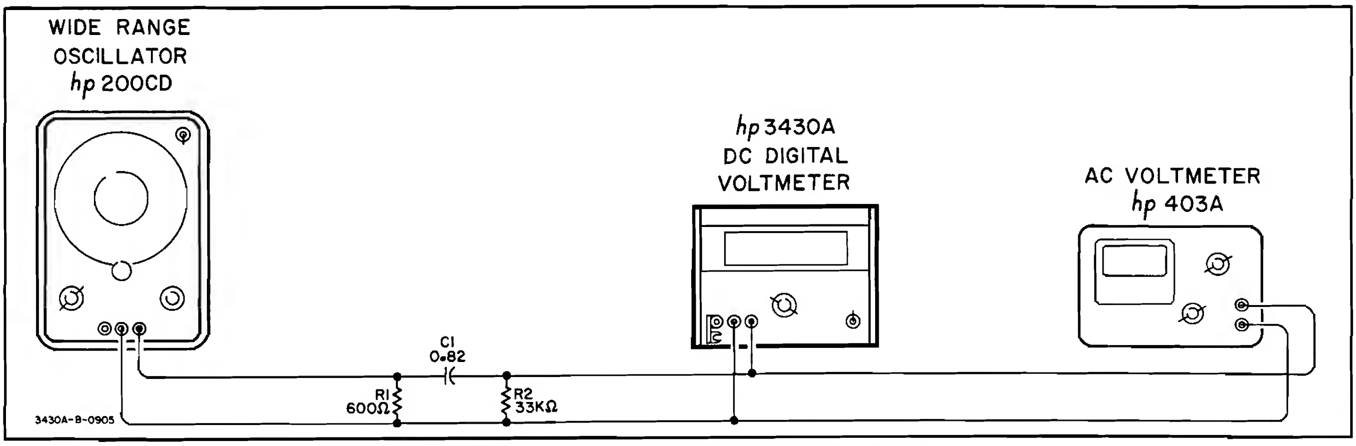


Figure 5-3. AC Superimposed Noise Check

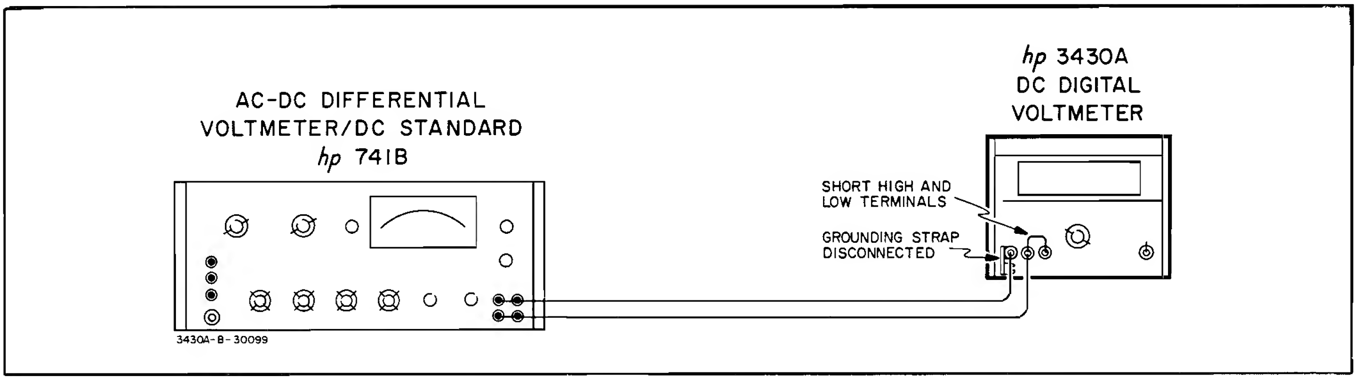


Figure 5-4. DC Common Mode Rejection Check

c. Gradually increase the dc standard voltage. The 3430A should indicate accurate voltages up to 15.99 volts. Input voltages above 15.99 volts should cause the display to flash, indicating overload condition. With a 1 count overload, the 3430A may indicate 19.99. This is normal.

5-10. AC SUPERIMPOSED NOISE REJECTION CHECK.

5-11. Figure 5-3 shows the AC Superimposed Noise Rejection Check. R1 is a 600 Ω load for the test oscillator. C3 blocks any dc from the oscillator output, and R2 provides a low source resistance for the 3430A input circuits.

a. Connect the 3430A as shown in Figure 5-3.

b. Zero the 3430A and set RANGE to 10 V.

c. Set oscillator frequency to 60 Hz. Using the ac voltmeter as a monitor, set test oscillator output to 1 V rms.

d. The 3430A reading should not change by more than ±2 digits.

5-12. DC COMMON MODE REJECTION CHECK.

a. Connect the 3430A as shown in Figure 5-4.

b. Zero the 3430A and set RANGE to 100 mV.

c. Set dc standard output to + 10 V.

d. The 3430A reading should not change more than ±3 digits.

5-13. AC COMMON MODE REJECTION CHECK.

a. Connect the 3430A as shown in Figure 5-5.

b. Zero the 3430A and set RANGE to 100 mV.

c. Set test oscillator to 60 Hz. Using the ac voltmeter as a monitor, set oscillator output to 7.07 V rms (10 V peak voltage).

d. The 3430A reading should not change more than ±3 digits.

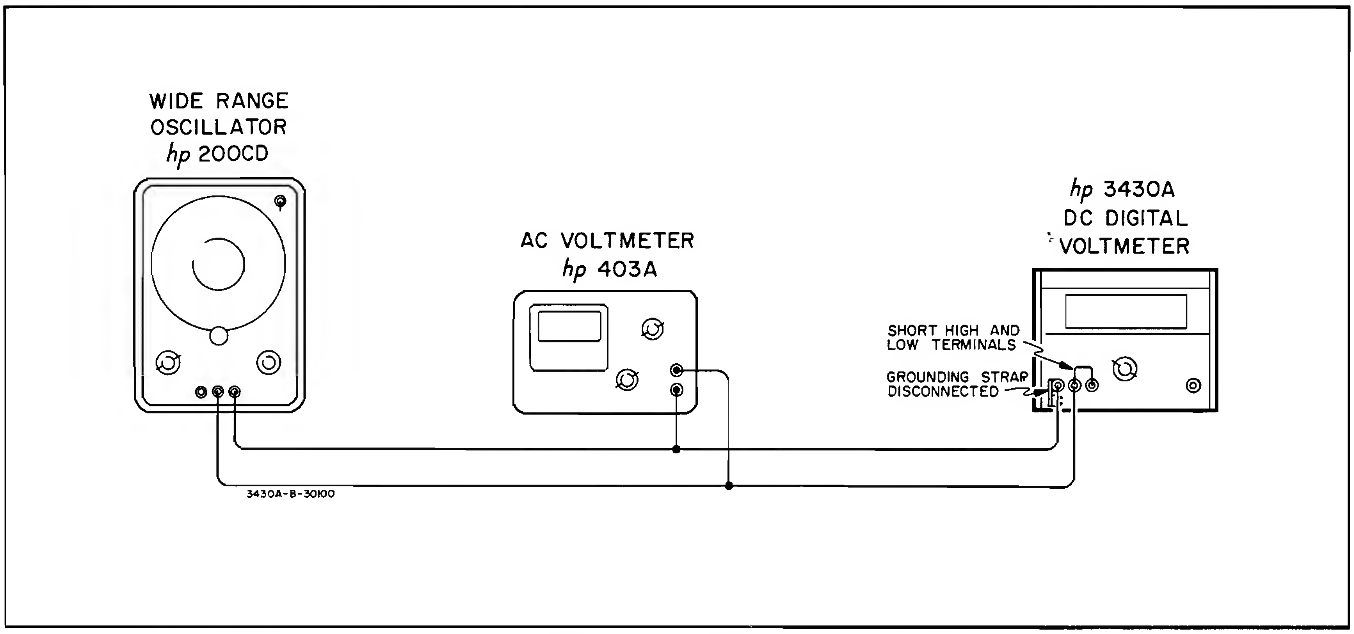


Figure 5-5. AC Common Mode Rejection Check

5-14. RATIO ACCURACY CHECK (Option 01 Only).

a. Set 3430A to 1000 mV scale and set the dc standard (-hp- Model 741B) to 0.80 volts. Set rear panel RATIO/NORMAL switch to RATIO.

b. Connect dc standard voltage to the 3430A front panel INPUT and rear panel REF INPUT. (See Figure 5-6.) This places the rear panel REF INPUT and front panel INPUT voltages in parallel, so the input ratio is 1.000.

c. Gradually increase the dc standard voltage from 0.80 to 1.20 volts. The 3430A digital display should read on or between 1003 mV and 997 mV.

d. Disconnect 3430A ground strap.

e. Position rear panel - REF + Switch to - (negative).

f. Repeat steps a through c of this paragraph with negative voltages.

g. The range attenuator and input amplifier determine the range accuracy and linearity of ratio measurements. Since the attenuator and input amplifier were checked by the DC Accuracy Check (Paragraph 5-7), the above ratio check is sufficient.

5-15. ADJUSTMENT AND CALIBRATION PROCEDURE.

5-16. The following test and adjustment procedures should be performed only if it has been definitely determined by the Performance Checks given in Paragraphs 5-5 through 5-14 that the Model 3430A is out of specifications. Figure 5-7 shows the location of internal adjustments.

NOTE

All voltage measurements made in this section are reference to circuit ground (⏚). The front panel INPUT terminal marked ⏚ and A1TP5 are circuit ground.

5-17. COVER REMOVAL.

a. To remove the top or bottom covers, remove the two Phillips screws at the rear of the cover, slide the cover about 1 inch to the rear, and lift off.

b. To remove the side covers, remove the four Phillips screws on each cover and lift off.

c. To replace covers, reverse the removal procedure.

5-18. POWER SUPPLY (A5 ASSEMBLY) ADJUSTMENT.

a. Supply the Model 3430A with primary power and turn LINE switch on.

b. Connect dc differential voltmeter (-hp- Model 741B) to A5TP1, and adjust A5R20 for a - 30.0 volt ±20 mV indication.

5-19. INPUT AMPLIFIER ZERO.

a. Short 3430A INPUT terminals.

b. Center the rear panel ZERO adjust on the 3430A.

c. Set 3430A RANGE to 100 mV.

d. Connect dc differential voltmeter (-hp- Model 741B) to A1TP1 (input amplifier output) and circuit ground (⏚).

e. Adjust A1R84 (coarse adjust) to give 0.0 V ±10 mV.

f. Adjust the ZERO adjust (ten turn potentiometer) on the rear panel of the 3430A to give zero volts ±0.5 mV at A1TP1.

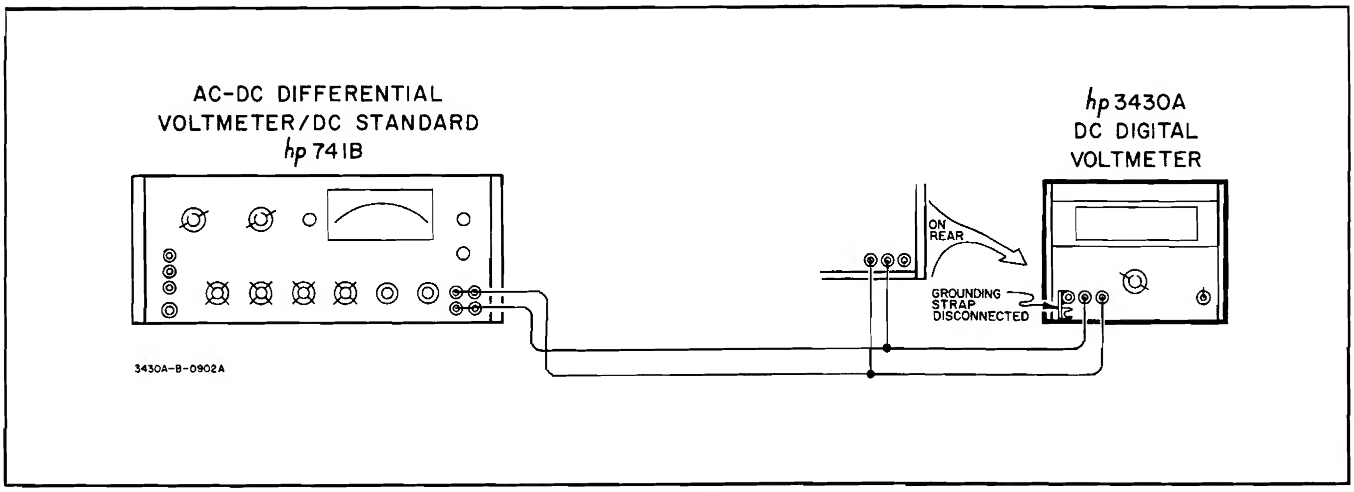


Figure 5-6. Ratio Accuracy Check

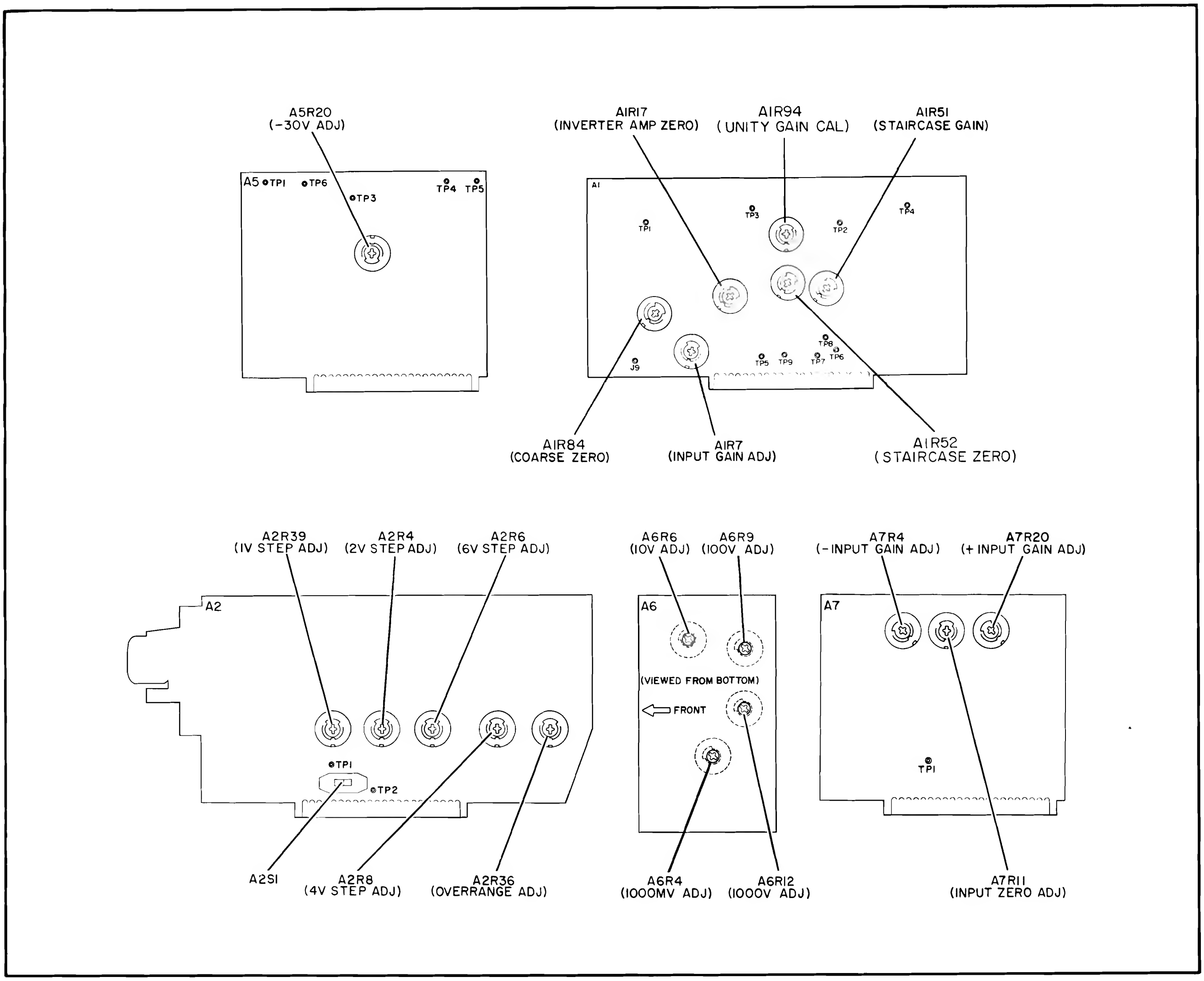


Figure 5-7. Location of Internal Adjustments

5-20. INPUT AMPLIFIER CALIBRATION.

a. Connect the Model 3430A, a dc standard and a dc differential voltmeter as shown in Figure 5-8. If a dc standard is not available, a suitable dc voltage source can be built using a mercury battery and wirewound potentiometers. The differential voltmeter can be used as a monitor to set the battery supply to the desired output.

b. Set the 3430A RANGE to 100 mV and set the dc differential voltmeter to 10 V range.

c. Set the dc standard output to - 99.0 mV.

d. Place a short across A1C11 in the Sample Oscillator. This stops the 3430A from sampling, eliminating any possible transient pickup.

e. Adjust A1R7 for differential voltmeter reading of - 9.90 volts. This adjusts the input amplifier gain.

f. Remove short from A1C11.

CAUTION

APPLY A NEGATIVE VOLTAGE TO INPUT TERMINALS BEFORE GROUNDING A1TP1. THIS NEGATIVE INPUT PREVENTS POWER SUPPLY OVERLOADING WHEN A1TP1 IS GROUNDED DURING INVERTER AMPLIFIER ADJUSTMENT (Paragraph 5-21).

5-21. INVERTER AMPLIFIER ADJUSTMENTS.

NOTE

This paragraph applies to instruments with serial number 933-02551 and higher. For instruments with prior serial numbers, see Appendix C.

a. Connect dc standard to 3430A INPUT. With 3430A RANGE set to 100 mV, adjust dc standard output to + 0.005 V.

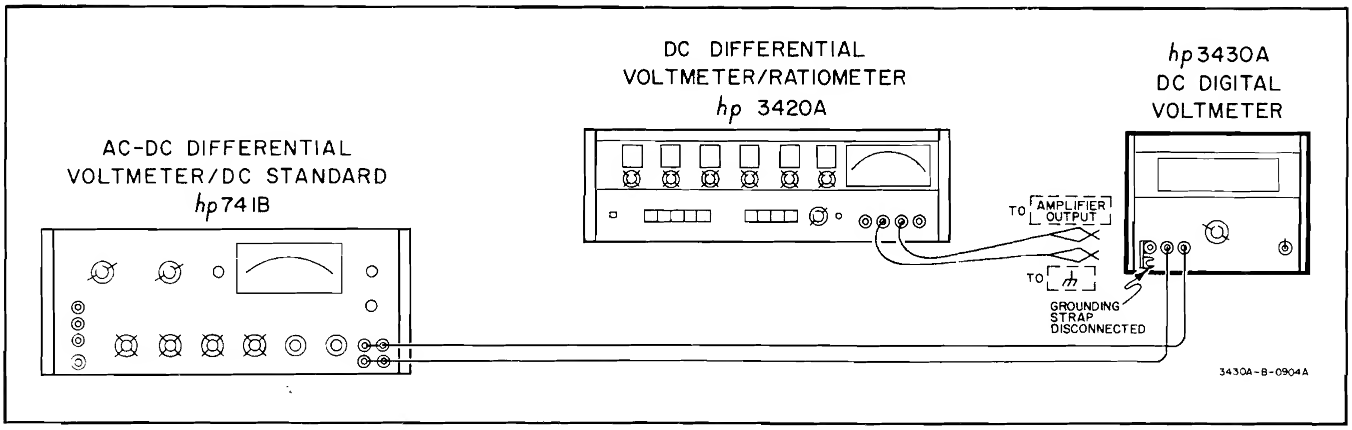


Figure 5-8. Input Amplifier Calibration

b. Using a dc differential voltmeter, measure and note voltage at A1TP1. Should be approximately +0.5 V.

c. Connect differential voltmeter to A1TP2. Adjust A1R17 (-1 AMP ZERO) to set voltage at A1TP2 equal in value but of opposite polarity to voltage noted in step b.

d. Change dc standard output to -0.0999 V. Measure and note voltage at A1TP2. Should be approximately -9.99 V.

e. Reverse polarity of dc standard output (+0.0999 V). Adjust A1R94 (UNITY GAIN CAL) to set voltage at A1TP2 to same value ±2 mV as voltage noted in step d.

NOTE

The Staircase Zero and Gain adjustment, the D/A converter adjustment, and the Staircase amplifier offset adjustment interact. Be sure to make these adjustments in the order given.

5-22. STAIRCASE AMPLIFIER ZERO AND GAIN ADJUSTMENT.

a. Connect dc standard to 3430A INPUT, and adjust its output for -99.0 mV.

b. Set 3430A RANGE to 10 V.

c. Disable the count gate by connecting a short between A1TP4 and A1TP5 (⏚).

d. Connect dc differential voltmeter to A1TP3.

e. Adjust A1R52 for a 0.0 V ±0.25 mV indication on differential voltmeter. This zeros the Staircase Amplifier.

f. Connect a 400 kΩ ±0.02% wirewound resistor between A1TP9 and A5TP3. This applies a known calibration voltage to the Staircase Amplifier. If a 400 kΩ ±0.02% resistor is not available use four 100 kΩ ± 0.02% resistors (-hp- Part No. 0811-0191).

g. Adjust A1R51 for a +1.000 volt reading on the differential voltmeter (-hp- Model 741B) at A1TP3. This adjusts the Staircase Amplifier gain.

h. Remove dc differential voltmeter from A1TP3 and remove short from A1TP4 to A1TP5.

i. Remove the 400 kΩ precision resistor from A5TP3 and A1TP9.

5-23. D/A CONVERTER ADJUSTMENT.

a. Do not adjust the hundreds D/A without first adjusting staircase amplifier (Paragraph 5-22).

b. Connect dc standard to 3430A INPUT.

c. Turn off 3430A and place A2 assembly into a 22 pin extender (-hp- Part No. 5060-0630), allowing adjustment to be made while the assembly is in the 3430A circuit.

d. Place dc differential voltmeter at A1TP3.

e. Set A2S1 slide switch to TEST position, removing the internal reset pulse going to the tens and units decade counters (A3 and A4 assemblies).

f. Turn on 3430A and set RANGE to 100 mV. Adjust dc standard so the 3430A displays +10.0 mV to +10.9 mV.

g. Connect short across A1C11 and then short A2TP2 to A5TP1. The order is important. This stops the 3430A from sampling and resets the tens and units decade counters to zero. The 3430A display should not change after the two shorts are connected. If the display changes, disconnect both shorts and reconnect until the display reads the same after shorting as before shorting.

h. Adjust A2R39 for +1.000 volts at A1TP3, then disconnect shorts across A1C11 and from A2TP2 to A5TP1.

i. Set dc voltage supply so the 3430A displays +20.0 mV to +20.9 mV.

j. Repeat step g of this paragraph.

k. Adjust A2R4 for + 2.000 volts at A1TP3, then disconnect shorts across A1C11 and from A2TP2 to A5TP1.

l. Set dc standard so the 3430A displays + 40.0 mV to + 40.9 mV.

m. Repeat step g of this paragraph.

n. Adjust A2R8 for +4.000 volts at A1TP3, then disconnect shorts across A1C11 and from A2TP2 to A5TP1.

o. Set dc standard so the 3430A displays + 60.0 mV to + 60.9 mV.

p. Repeat step g of this paragraph.

q. Adjust A2R6 for +6.000 volts at A1TP3, then disconnect shorts across A1C11 and from A2TP2 to A5TP1.

r. Set dc standard so the 3430A displays + 100.0 mV to +100.9 mV.

s. Repeat step g of this paragraph.

t. Adjust A2R36 for + 10.000 volts at A1TP3.

u. Turn 3430A line switch to OFF.

v. Remove shorts from A2TP2 to A5TP1 and across A1C11 and remove dc differential voltmeter from A1TP3. Set A2S1 to OPERATE.

w. Remove A2 assembly from the extender and install A2 assembly in the instrument.

5-24. STAIRCASE AMPLIFIER OFFSET.

5-25. The staircase offset adjusts the comparator switching point by biasing the staircase ramp.

a. Turn on 3430A.

b. Set the 3430A RANGE to 100 volts.

c. Connect dc standard to 3430A INPUT.

d. Connect the dc differential voltmeter to A1TP1.

e. Adjust the dc standard output until the dc differential voltmeter reads -15.0 mV ± 0.5 mV. Slowly adjust A1R52 until the 3430A display just changes from - 00.1 V to 00.2 V.

f. Adjust the dc standard output until the differential voltmeter reading is + 15.0 mV. Slowly adjust A1R17 until the display just changes from + 00.1 V to + 00.2 V.

5-26. INPUT ATTENUATOR CALIBRATION.

5-27. The Input Attenuator Calibration requires a dc standard (-hp- Model 741B). The calibration should be performed only if all the preceding adjustment and calibration procedures have been performed.

a. Allow the 3430A to warm up at least 10 minutes.

b. Set 3430A RANGE to 1000 mV, short 3430A INPUT terminals, and adjust ZERO on the back panel.

c. Connect dc standard to 3430A INPUT.

d. Set dc standard to + 999.0 mV.

e. Adjust potentiometer A6R4 for 3430A display of +999.0 mV.

f. Repeat steps d and e for the values shown in Table 5-3.

Table 5-3. Attenuator Adjustment

DC Standard Setting	RANGE Switch Setting	Make Adjustment On	3430A Display
+ 99.90 mV	100 mV	A1R7	+ 99.9 mV
+ 999.0 mV	1000 mV	A6R4	+ 999. mV
+ 9.990 V	10 V	A6R6	+ 9.99 V
+ 99.90 V	100 V	A6R9	+ 99.9 V
+ 999.0 V	1000 V	A6R12	+ 999. V

5-28. RATIO CALIBRATION (Option 01 Only).

a. Turn 3430A off and place A7 Ratio Reference Amplifier on 22 pin extender board. Turn 3430A back on and allow 10 minute warm up.

b. Set RATIO/NORMAL switch to NORMAL and RANGE switch to 1000 mV.

c. Connect dc differential voltmeter to A5TP3 (-9 V ref) and record the voltage to 4 significant digits.

d. Disconnect differential voltmeter from A5TP3 and connect it to A7TP1.

e. Set RATIO/NORMAL switch to RATIO and + REF - switch to + .

f. Short rear panel REF INPUT to (⏚).

g. Zero the Ratio Reference Amplifier by adjusting A7R11 for a 0.0 V ±0.25 mV reading on the dc differential voltmeter.

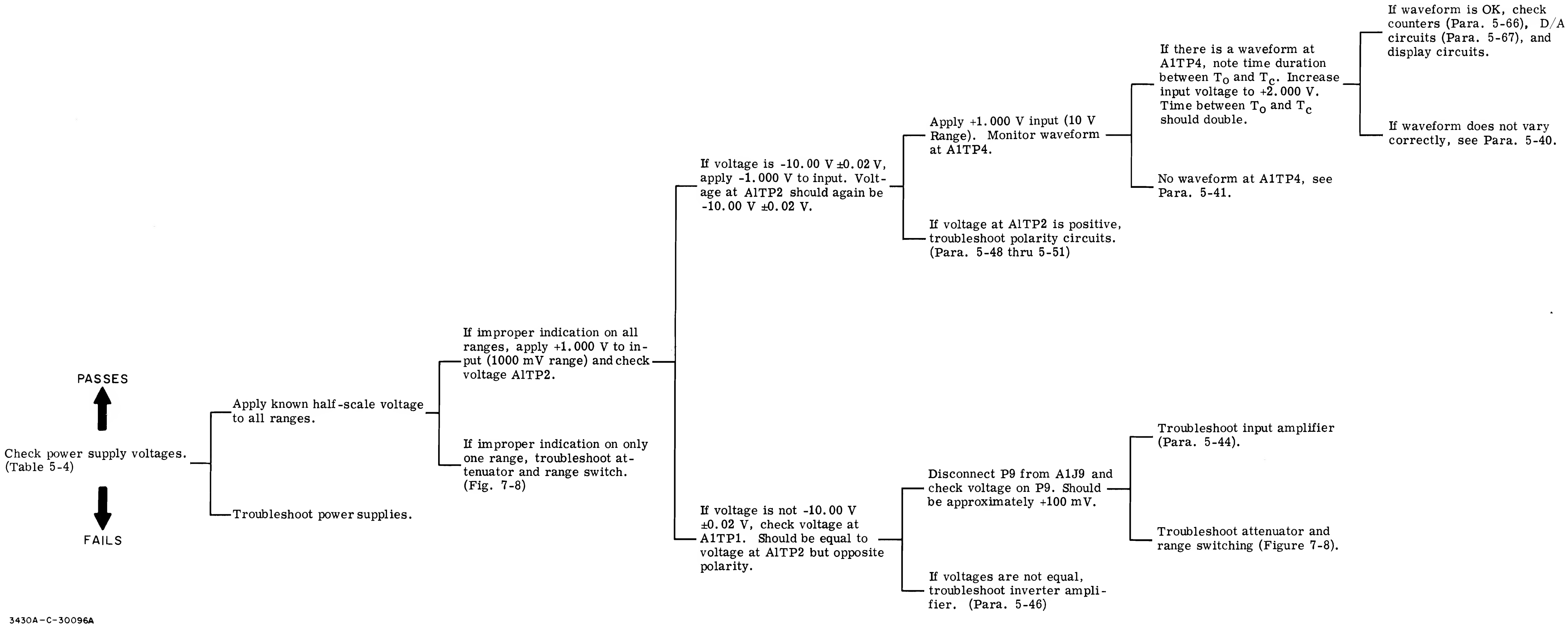
h. Remove short and connect dc standard in parallel to INPUT and REF INPUT terminals. Set standard output to + 1.000 V.

i. Adjust A7R20 for a differential voltmeter reading at A7TP1 equal to the reading recorded in step c.

j. Set + REF - switch to - and reverse polarity of dc standard input. Remove shorting bar between ⏚ and ⏚ terminals.

k. Adjust A7R4 for a differential voltmeter reading equal to the reading recorded in step c.

l. Turn instrument off and place A7 assembly in its connector.



TROUBLESHOOTING TREE

Figure 5-9. Troubleshooting Tree

5-29. TROUBLESHOOTING.

5-30. When the Model 3430A operates improperly, first adjust and calibrate it according to the procedures in Paragraph 5-15. If calibration is impossible, then proceed with the troubleshooting steps. Make sure that the trouble is not a result of conditions external to the 3430A and check for possible burned or loose components, loose connections, or any other condition which might suggest a source of trouble. Check all printed circuit boards for separations or cracks and make certain that all pins are clean and tight.

5-31. Using the block diagram and troubleshooting tree (Figure 5-9), and the troubleshooting procedure (Paragraph 5-32), isolate the trouble to a particular circuit or assembly. Then refer to the detailed troubleshooting procedure for that circuit.

5-32. TROUBLESHOOTING PROCEDURE.

5-33. The following procedure provides a quick method of isolating a malfunction to a particular circuit or assembly. Once the trouble is isolated to a given circuit, refer to the detailed troubleshooting paragraph given for that circuit. This procedure requires a dc differential voltmeter, an oscilloscope, and a dc standard.

NOTE

Whenever making measurements at A1TP2, connect a 1 MΩ isolation resistor between A1TP2 and the input to the test instrument.

5-34. PRELIMINARY CHECKS.

a. Check power supply voltages. Table 5-4 lists correct voltages at A5 test points. All voltages are referenced to circuit ground (⏚).

Table 5-4. Power Supply Voltages

Test Point	Nominal Voltage (115 V Line)	Typical Variation with ±10% Line Voltage Change	Typical Ripple
A5TP1	-30.00±0.02 V	±0.05 V	10 mV p-p
A5TP3	- 9.00±0.50 V	±0.002 V	5 mV p-p
A5TP4	+30.00±0.90 V	±0.02 V	5 mV p-p
A5TP5	+17.00±0.50 V	±0.01 V	5 mV p-p
A5TP6	+ 4.00±0.12 V	±0.008 V	2 mV p-p

NOTE

The value of the - 9 V reference voltage measured at A5TP3 affects the value of factory selected resistors A1R3*, A1R50*, A7R12*, and A7R19*. If the - 9 V reference zener diode A5CR7 is changed, refer to Paragraph 5-76.

b. If power supply voltages are correct, apply a known half-scale voltage to all ranges. If an improper indication appears on only one range, trouble is in attenuator. If it appears on all ranges, trouble is elsewhere.

5-35. ANALOG CIRCUITS (Positive Input).

a. Set RANGE to 1000 mV, RATIO/NORMAL (Option 01 only) to NORMAL. Connect dc voltmeter between transfer (moveable) contact on top left of A1TP2 and ground and connect + 1.000 V from dc standard to INPUT. Reading at A1TP2 should be - 10.00 V ±0.02 V. If reading is OK, input amplifier, inverter amplifier and attenuator are OK, proceed to Paragraph 5-36.

b. If voltage at A1TP2 is incorrect, check voltage at A1TP1. Voltages at A1TP1 and A1TP2 should be equal in magnitude, but voltage at A1TP1 should be positive. If not, trouble is in Inverter Amplifier. (See Paragraph 5-46.)

c. If voltages at A1TP1 and A1TP2 are equal but not 10.00 V, disconnect P9 connector from A1J9 connector and connect dc voltmeter to P9. Voltage should be approximately + 100 mV. (Voltmeter will cause slight loading error.) If voltage is not + 100 mV, trouble is in attenuator or switching; if reading is OK, trouble is in input amplifier. (See Paragraph 5-44.)

5-36. ANALOG CIRCUITS (Negative Input).

5-37. Set dc standard output to - 1.000 Vdc and connect dc voltmeter to A1TP2. Voltage at A1TP2 should be - 10.00 V ±0.04 V. If voltage at A1TP2 is positive, trouble is in polarity circuits. (See Paragraph 5-48 and 5-50.)

5-38. DIGITAL CIRCUITS.

5-39. With 3430A on 10 V range, connect +1 V input and monitor waveform at the comparator flip-flop (A1TP4) with an oscilloscope. The proper waveform is shown in Figure 5-10A. Note the time duration between T_O and T_C. Increase input voltage to + 2 V. Time between T_O and T_C should increase by a factor of 2. If waveform at A1TP4 is OK, all circuits except the counter, D/A, and display circuits are working, but may not be calibrated.

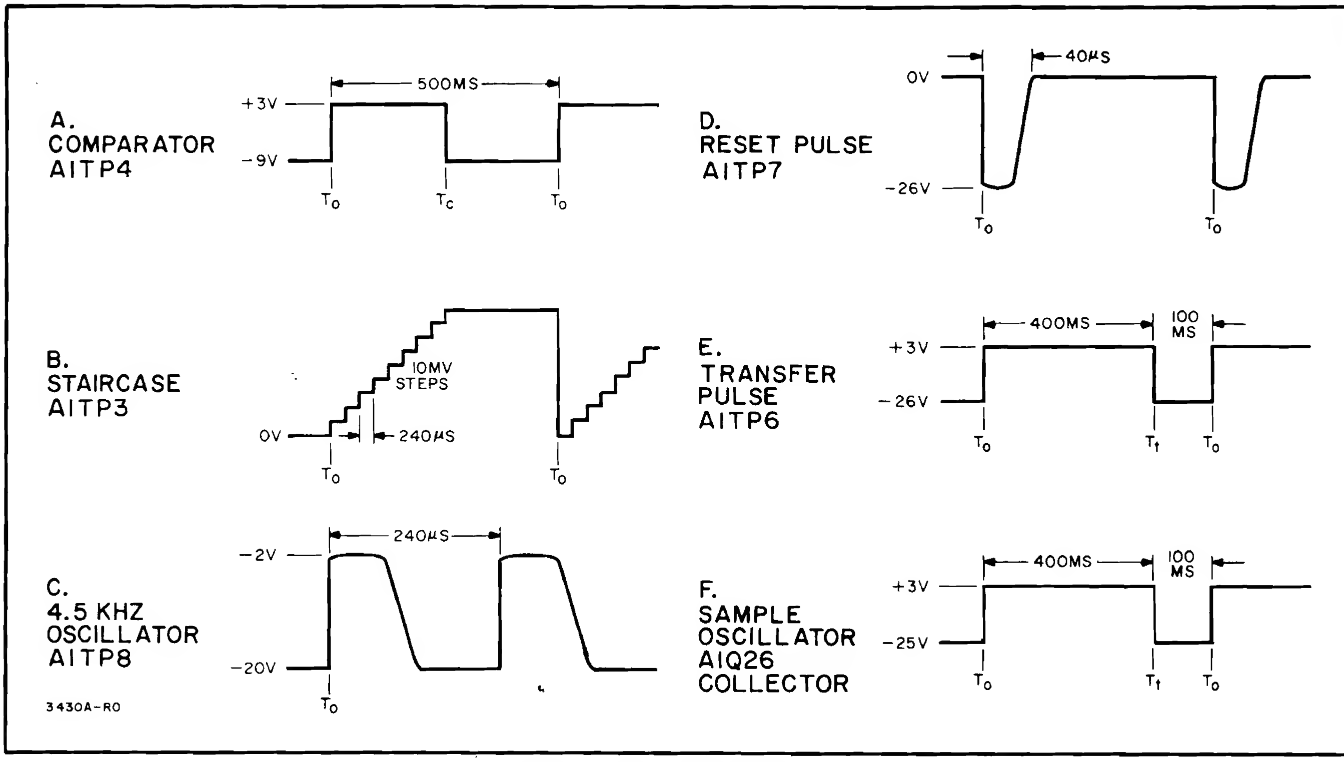


Figure 5-10. Waveforms

5-40. Incorrect Waveform at A1TP4. If there is a waveform at A1TP4, the comparator, sample oscillator, reset amplifier, and transfer amplifier are OK. Also, the staircase amplifier must be operating. However, if the time between T_O and T_C does not vary in proportion to the input, the staircase voltage is incorrect.

a. Monitor the staircase amplifier output (A1TP3) with an oscilloscope, and compare the staircase with the waveform shown in Figure 5-10B. Each step should be 10 mV amplitude and approximately 240 μsec in duration. If staircase amplitude is incorrect, check staircase amplifier gain (Paragraph 5-22) and D/A adjustments (Paragraph 5-23). If staircase gain cannot be adjusted, refer to the staircase amplifier troubleshooting procedure (Paragraph 5-64).

b. If staircase is discontinuous or intermittent, trouble is in 4.5 kHz oscillator, decade counters, or D/A converters. Apply an overload input and connect an oscilloscope to A1TP8. Compare 4.5 kHz oscillator waveform with waveform in Figure 5-10C. If waveform is incorrect, trouble is in 4.5 kHz oscillator (Paragraph 5-62). If waveform is OK, trouble is in D/A converter or counters (Paragraphs 5-66 and 5-67).

5-41. No Waveform at A1TP4. If there is no waveform at A1TP4, the digital circuits are not operating. Either the comparator is not working, the timing circuits are not working, or there is no staircase. Since the timing circuits operate independently, they should be checked first. Connect oscilloscope to A1TP7 and check for a reset pulse. (See Figure 5-10D.) If the reset pulse is OK, proceed to Paragraph 5-41a. If the reset pulse is incorrect, check the transfer pulse waveform at A1TP6. (See Figure 5-10E.) If the transfer pulse is OK, the trouble is in the Reset Amplifier. If the transfer pulse is incorrect, connect an oscilloscope to the Sample Oscillator output (collector A1Q26), and check for waveform shown in Figure 5-10F. If the Sample Oscillator waveform is OK, trouble is in Transfer Amplifier (Paragraph 5-58); if not, trouble is in Sample Oscillator (Paragraph 5-60).

a. If the timing circuits are OK, trouble may be in Staircase circuits or comparator circuits. Connect oscilloscope to A1TP3, and monitor staircase waveform. If there is a staircase waveform at A1TP3, the staircase circuits are functioning, and the trouble is probably in the comparator circuits. (See Paragraphs 5-52 and 5-54.) If there is no staircase, proceed to b.

b. Check the staircase amplifier by connecting a 400 kΩ resistor between A5TP3 and A1TP9 and monitoring the dc voltage at A1TP3. The reading at A1TP3 should be + 1.0 V. If reading is OK, proceed to c. If reading is incorrect, trouble is in staircase amplifier. (See Paragraph 5-64.)

c. Check 4.5 kHz oscillator waveform at A1TP8. Figure 5-10C shows proper waveform. If waveform is incorrect, trouble is probably in oscillator. (See Paragraph 5-62.) If waveform is OK, trouble is probably in counters or D/A. (See Paragraphs 5-66 and 5-67.)

5-42. DISPLAY.

5-43. If checks made in Paragraphs 5-34 through 5-41 show no trouble, yet display is incorrect, check display circuits or recheck calibration of instrument.

NOTE

The test voltages shown in this section are nominal. A tolerance of ±10% is acceptable.

5-44. INPUT AMPLIFIER.

5-45. If trouble is isolated to the input amplifier, measure voltages and compare with Table 5-5. Connect short across INPUT terminals and adjust zero before making measurements.

Table 5-5. Input Amplifier Voltages With Zero INPUT

Test Point		Voltage
A1Q1A	gate	0.0 V
	source	+ 2.0 V
	drain	+ 8.5 V
A1Q1B	gate	0.0 V
	source	+ 2.0 V
	drain	+ 8.5 V
A1Q2	base	0.0 V
	collector	+ 2.0 V
	emitter	- 0.6 V
A1Q3	base	+ 8.7 V
	collector	+ 17.0 V
	emitter	+ 8.2 V
A1Q4	base	+ 8.7 V
	collector	+ 16.9 V
	emitter	+ 8.2 V

5-46. INVERTER AMPLIFIER.

5-47. Set 3430A on 1000 mV RANGE and connect + 1000 mV to INPUT. Correct voltages are shown in Table 5-6.

Table 5-6. Inverter Voltages

With + 1000 mV INPUT on 1000 mV RANGE

Test Point		Voltage
A1Q10A	emitter	- 0.6 V
	base	0.0 V
	collector	+ 4.0 V
A1Q10B	emitter	- 0.6 V
	base	0.0 V
	collector	+ 4.0 V
A1Q11	emitter	+ 3.4 V
	base	+ 4.0 V
	collector	+ 16.3 V
A1Q12	emitter	+ 4.0 V
	base	+ 3.4 V
	collector	- 10.6 V
A1TP2		- 10.0 V

5-48. POLARITY SWITCH.

5-49. Set 3430A on 1000 mV RANGE and connect + 1000 mV and then -1000 mV to INPUT. Correct voltages are shown in Table 5-7.

Table 5-7. Polarity switch Voltages.

Test Point		Voltage	
		+1000 mV INPUT	-1000 mV INPUT
A1Q31	emitter	-10.0 V	-10.0 V
	base	-10.6 V	- 9.4 V
	collector	+10.0 V	-10.0 V
A1Q12	emitter	+ 4.0 V	+ 4.0 V
	base	+ 3.4 V	+ 3.4 V
	collector	-10.6 V	+ 3.9 V

5-50. POLARITY FLIP-FLOP.

5-51. Set 3430A on 1000 mV RANGE and connect + 1000 mV and then - 1000 mV to INPUT. Correct voltages are shown in Table 5-8.

Table 5-8. Polarity Flip-Flop Voltages

Test Point		Voltage	
		+1000 mV INPUT	-1000 mV INPUT
A1Q24	emitter	- 0.0 V	0.0 V
	base	- 0.8 V	+ 3.5 V
	collector	- 0.1 V	- 15.2 V
A1Q25	emitter	0.0 V	0.0 V
	base	+ 0.1 V	- .78 V
	collector	- 16.6 V	- 0.1 V

5-52. COMPARATOR.

5-53. Set 3430A on 1000 mV RANGE and connect short circuit across INPUT terminals. Adjust ZERO control on rear panel. Correct voltages are shown in Table 5-9.

Table 5-9. Comparator Voltages

With Shorted INPUT Terminals and Display of 000

Test Point		Voltage
A1Q13A	emitter	- .6 V
	base	0.0 V
	collector	+ 4.0 V
A1Q13B	emitter	- 0.6 V
	base	0.0 V
	collector	+ 4.0 V
A1Q14	emitter	+ 3.7 V
	base	+ 4.0 V
	collector	+ 13.5 V
A1Q15	emitter	+ 4.0 V
	base	+ 3.7 V
	collector	- 8.5 V

5-54. COMPARATOR FLIP-FLOP.

5-55. Set 3430A on 1000 mV RANGE and connect short circuit across INPUT terminals. Adjust ZERO control on rear panel. Voltages should be approximately as in Table 5-10.

Table 5-10. Comparator Flip-Flop Voltages With Shorted INPUT Terminals

Test Point		Voltage
A1Q16	emitter	0.0 V
	base	- 0.7 V
	collector	0.0 V
A1Q17	emitter	0.0 V
	base	- 0.32 V
	collector	- 20.7 V

5-56. RESET AMPLIFIER.

5-57. Connect short circuit across A1C11. This will disable the sample oscillator. Correct voltages are shown in Table 5-11.

Table 5-11. Reset Amplifier Voltages With A1C11 Shorted

Test Point		Voltage
A1Q29	emitter	- 29.2 V
	base	- 29.7 V
	collector (A1TP7)	+ 0.5 V

5-58. TRANSFER AMPLIFIER.

5-59. Connect short across A1C11. This will disable sample oscillator. Correct voltages are shown in Table 5-12.

Table 5-12. Transfer Amplifier Voltages A1C11 Shorted

Test Point		Voltage
A1Q28	emitter	+ 3.7 V
	base	+ 4.4 V
	collector (A1TP6)	+ 4.0 V

5-60. 2 HZ SAMPLE OSCILLATOR.

5-61. Connect short circuit across A1C11 to disable circuit. Correct voltages are shown in Table 5-13.

Table 5-13. Sample Oscillator Voltages With A1C11 Shorted

Test Point		Voltage
A1Q26	emitter	*
	base	- 29.7 V
	collector	+ 4.4 V
A1Q27	emitter	- 7.7 V
	base	- 7.0 V
	collector	- 30.0 V

* Do not measure

5-62. 4.5 KHZ OSCILLATOR.

5-63. Connect short circuit across A1C8 to stop oscillator. Correct voltages are shown in Table 5-14.

Table 5-14. 4.5 kHz Oscillator Voltages With A1C11 and A1C8 Shorted

Test Point		Voltage
A1Q8	emitter	*
	base	0.0 V
	collector	- 18.9 V
A1Q9	emitter	*
	base	- 9.9 V
	collector	0.0 V

* Do not measure

5-64. STAIRCASE AMPLIFIER.

5-65. Connect short circuit across INPUT of 3430A and adjust rear panel ZERO. Correct voltages are shown in Table 5-15.

Table 5-15. Staircase Amplifier Voltages

Test Point		Voltage
A1Q18A	emitter	- .6 V
	base	0.0 V
	collector	+ 17.0 V
A1Q18B	emitter	- .6 V
	base	0.0 V
	collector	+ 17.0 V
A1Q19	emitter	+ 16.4 V
	base	+ 17.0 V
	collector	+ 29.2 V
A1Q20	emitter	+ 17.0 V
	base	+ 16.4 V
	collector	0.0 V

5-66. COUNTER CIRCUITS.

a. Set 3430A RANGE to 1000 mV and apply + 2.0 V to input. Then connect short across A1C11. This will allow counter to free-run. Connect oscilloscope to units counter output (A4 pin 14). The output waveform should be similar to the 4.5 kHz oscillator waveform (Figure 7-2), but 1/10th the frequency. If waveform is OK, proceed to b. If waveform is incorrect, connect oscilloscope to collector of A4Q2, A4Q4, A4Q6, and A4Q8 respectively. In each case the waveform should be a switching waveform. If not, the trouble is in the binary associated with transistor under test.

b. Connect oscilloscope to tens counter output (A3 pin 14). Output waveform should be similar to units counter output waveform, but 1/10th the frequency. If waveform is OK, proceed to c. If waveform is incorrect, connect oscilloscope to collector of A3Q2, A3Q4, A3Q6, and A3Q8 respectively. In each case the waveform should be a switching waveform. If not, the trouble is in the binary associated with transistor under test.

c. Connect oscilloscope to hundreds counter output (collector of A2Q7). The output waveform should be similar to the tens counter output, but 1/10th the frequency. If waveform is OK, trouble is in overrange binary (A2Q20 and A2Q21) or overrange flip-flop (A2Q26 and A2Q27). If waveform is incorrect, check waveform at collector of A2Q2, A2Q4, and A2Q6 respectively. In each case the waveform should be a switching waveform. If not the trouble is in the binary associated with the transistor under test.

5-67. D/A CONVERTERS.

5-68. The D/A converters can best be checked by analyzing the front panel indication.

a. Set 3430A RANGE to 100 V. Connect dc standard to INPUT. Set dc standard to 100 V. If overrange digit should light, proceed to b. Otherwise trouble is in overrange D/A.

b. Set 3430A RANGE to 1000 V and apply + 10 V. Hundreds digit (most significant) should be zero. Increase input to 110 V. Hundreds digit should change to 1. Increase input voltage in 100 V increments to 910 V. Each time input voltage is increased, hundreds digit should increase by 1. If hundreds digit indication is OK, proceed to step c. If not, trouble is in hundreds D/A.

c. Set dc standard to 5 V. Tens (center) digit should be zero. Increase input voltage to 15 V. Tens digit should change to 1. Increase input voltage in 10 volt increments to 95 volts. Each time voltage is changed, tens digit should increase by 1. If tens digit is OK, proceed to step d. If not, trouble is in tens D/A.

d. Set dc standard to 0 volts. Units (least significant) digit should be zero. Set standard to 1.0. Units digit should change to 1. Increase standard output in 1 V increments to 9 V. Each time voltage is increased, units digit should increase by 1. If indication is OK, trouble is not in D/A converters. If not, trouble is in units D/A.

5-69. OPTION: RATIO REFERENCE AMPLIFIER.

5-70. Set 3430A on 10 V RANGE. Connect +1 V dc to rear panel REF input. Set REF ±slide switch to + and set RATIO/NORMAL slide switch to RATIO. Connect + 10 volts to front panel INPUT. Correct voltages are shown in Table 5-16.

Table 5-16. Option 01 Ratio Reference Amp Voltages

Test Point		Voltage
A7Q1A	source drain gate	+ 2.0 V + 8.3 V 0.0 V
A5Q1B	source drain gate	+ 2.0 V + 8.3 V 0.0 V
A7Q2	emitter base collector	- 1.3 V - 0.7 V + 2.0 V
A7Q3	emitter base collector	+ 7.8 V + 8.3 V + 11.9 V
A7Q4	emitter base collector	+ 7.8 V + 8.3 V + 14.2 V
A7Q5	emitter base collector	+ 13.9 V + 11.6 V + 14.2 V
A7Q6	emitter base collector	+ 3.8 V + 3.2 V - 8.9 V

5-71. ADJUSTMENT OF FACTORY SELECTED COMPONENTS.

5-72. Eight resistors within the Model 3430A are individually selected in order to compensate for slightly varying circuit parameters. These resistors are denoted by an asterisk (*) on the schematic, and the typical value is shown. The following paragraphs describe the function of the factory selected components, and give instructions for their selection. Normally, these components need not be changed unless another associated component is changed. Replacement of the reference voltage zener diode for example, may require changing a factory selected component.

5-73. A6R3*.

a. A6R3* adjusts the total resistance of the input attenuator. A6R3* should never be changed unless A6R2 or A6R4 is replaced.

b. If the 3430A cannot be calibrated to Paragraphs 5-26 and 5-27, A6R3* should be changed. If adjustment of A6R4, A6R6, A6R9, or A6R12 result in consistently high or low voltage readings at A1TP1, A6R3* should be changed. If the absolute value of the voltage at A1TP1 is high, increase the resistance of A6R3*.

c. Factory values of A6R3* vary from 100 ohms to 110 kΩ.

d. Changing A6R3* requires recalibration of the Input Attenuator (Paragraph 5-26).

5-74. A1R14*.

a. A1R14* may be used to adjust the feedback of the inverter amplifier. The amplifier gain should be -1. For example, if the voltage at A1TP1 is +10.000 V, the voltage at A1TP2 should be -10.000 V. If A1R15 and A1R16 are equal in value, A1R14* becomes zero ohms and a shorting wire is inserted in the printed circuit board in place of A1R14*. A1R15 and A1R16 are matched for resistance value and temperature coefficient. There should be no reason to change A1R14* unless A1R15 or A1R16 is changed.

b. If A1R15 and A1R16 are not matched in value to within 1.5 ohms, the resistor with the higher value should be placed in the A1R15 position, and the one with the lower value in the A1R16 position. A1R14* should then be selected to adjust the gain of the amplifier. With 100.0 mV input to the 3430A on the 100 mV range, A1R14* should be increased 1.5 ohms per millivolt of error at A1TP2, to a maximum of 9.0 ohms.

c. Adjusting the value of A1R14* requires no further calibration.

5-75. A1R4* and A1R5*.

a. A1R4* and A1R5* are selected to adjust the bias of A1Q1A and A1Q1B in order to correct for zero drift of up to 3 counts during instrument warmup. Decreasing A1R4* or increasing A1R5* by 1 kΩ will shift the temperature coefficient of the amplifier about -10 $\mu V/^{o}C$, correcting for approximately 1 count of positive drift. Increasing A1R4* or decreasing A1R5* by 1 kΩ will shift the temperature coefficient about +10 $\mu V/^{o}C$. Since A1R4* and A1R5* have a tolerance of ±1%, a replacement resistor should be compared to the original on a high resolution ohmmeter or bridge to be sure the desired change is being made.

b. If the zero drift cannot be corrected by adjusting the value of A1R4* or A1R5*, or is greater than 3 counts, and the power supply voltages and regulation are satisfactory, (see Table 5-4), A1Q1, A1Q2, A1Q3 or A1Q4 may be defective.

c. Changing A1R4*, A1R5*, A1Q1, A1Q2, A1Q3, or A1Q4 requires recalibration of the input amplifier zero and gain (see Paragraphs 5-19 and 5-20).

5-76. A1R3*, A1R50*, A7R12* (Option 01), and A1R19* (Option 01).

a. The value of factory selected resistors A1R3*, A1R50*, A7R12*, and A7R19* is affected by the actual voltage of the - 9 V reference supply. It should not be necessary to change any of these resistors unless the - 9 V reference zener diode A5CR7 or the power supply assembly A5 is changed. Table 5-17 shows suggested values for these resistors for various - 9 V reference voltages. Since parameters other than the - 9 V reference supply may affect the values of these resistors, the values determined by the use of Table 5-17 may not be optimum.

b. Measure the - 9 V reference voltage at A5TP3 and locate the corresponding point at the sides of Table 5-17. Place a straightedge across Table 5-17 and determine the resistor value in the appropriate column.

c. A1R3* controls the current in the constant current source in the input amplifier. Changing A1R3* requires no additional calibration.

d. A1R50* controls the staircase amplifier gain. If adjustment of A1R51 in Paragraph 5-22, step g, results in consistently low voltage readings, decrease the negative feedback to the amplifier by increasing A1R50*. Changing A1R50* requires recalibration of the staircase amplifier gain (see Paragraph 5-22).

e. A7R12* controls the zero range of the ratio reference amplifier. If adjustment of A7R11 in Paragraph 5-28, step h, results in a consistently negative voltage at A7TP1, increase the resistance of A7R12*. Changing A7R12* requires calibration of the ratio reference amplifier (see Paragraph 5-28).

f. A7R19* controls the feedback of the ratio reference amplifier. If adjustment of A7R20 in Paragraph 5-28, step i, results in voltage readings that are consistently too negative, increase the feedback by decreasing A7R19*. Changing A7R19* requires calibration of the ratio reference amplifier (see Paragraph 5-28).

5-77. A2C9*.

5-78. The value of A2C9* may be changed to correct for lack of sensitivity to small voltage changes when there is a count of 4 in the hundreds decade. For example, if, with a count of 400 in the instrument it does not respond to an increase of 1, 2, or 3 counts in the units decade, the value of A2C9* may be increased. The maximum value permissible is 360 pF. A dipped mica capacitor should be used.

5-79. A5R29*

5-80. The value of A5R29* is selected to bring A5R20 within the proper range. If A5R20 cannot be adjusted to the correct voltage in Paragraph 5-18, A5R29* may be changed. A 1% metal film resistor should be used. The value may vary from 0 Ω to 400 Ω.

Table 5-17. Factory Selected Resistor Values

-9V REF

9.40, 9.30, 9.20, 9.10, 9.0, 8.90, 8.80, 8.70, 8.60

A1R3*	A1R50*	A7R19*	A7R12*
23.7K 0698-3158	1K 0757-0280	63.4K 0698-3280	20.5K 0698-3245
23.2K 0698-4485	1.4K 0698-4424	57.6K 0698-4500	20.0K 0757-0449
22.6K 0757-0349	1.78K 0757-0278	52.3K 0757-0272	19.6K 0698-3157
22.1K 0757-0450	2.15K 0698-0084	47.5K 0757-0457	19.1K 0698-4484
21.5K 0757-0199	2.49K 0698-4435	43.2K 0757-0456	18.7K 0698-4483
	2.61K 0698-0085	39.2K 0757-0124	18.2K 0757-0448
	2.87K 0698-3151	35.7K 0698-4494	
	3.16K 0757-0279	32.4K 0698-4492	
	3.40K 0698-4440	28.7K 0698-3449	
	3.92K 0757-0435	26.1K 0698-3159	
	4.32K 0757-0436	23.7K 0698-3158	
	4.64K 0698-3155		
	4.99K 0698-3279		

ALL RESISTOR VALUES ±1%, 1/8W METAL FILM
-HP- PART NUMBERS SHOWN

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. Table 6-1 lists parts in alphameric order of their reference designators and indicates the description, -hp- part number of each part, together with any applicable notes, and provides the following:

a. Total quantity used in the instrument (TQ column). The total quantity of a part is given the first time the part number appears.

b. Description of the part. (See list of abbreviations below.)

c. Typical manufacturer of the part in a five-digit code. (See Appendix A for list of manufacturers.)

d. Manufacturer's part number.

6-3. Miscellaneous parts are listed at the end of Table 6-1.

6-4. ORDERING INFORMATION.

6-5. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Field Office. (See Appendix B for list of office locations.) Identify parts by their Hewlett-Packard part numbers. Include instrument model and serial numbers.

6-6. NON-LISTED PARTS.

6-7. To obtain a part that is not listed, include:

a. Instrument model number.

b. Instrument serial number.

c. Description of the part.

d. Function and location of the part.

DESIGNATORS

A	= assembly	F	= fuse	MP	= mechanical part	TC	= thermocouple
B	= motor	FL	= filter	P	= plug	V	= vacuum tube, neon bulb, photocell, etc.
BT	= battery	HR	= heater	Q	= transistor	W	= cable
C	= capacitor	IC	= integrated circuit	QCR	= transistor-diode	X	= socket
CR	= diode	J	= jack	R	= resistor	XDS	= lampholder
DL	= delay line	K	= relay	RT	= thermistor	XF	= fuseholder
DS	= lamp	L	= inductor	S	= switch	Z	= network
E	= misc electronic part	M	= meter	T	= transformer		

ABBREVIATIONS

Ag	= silver	ID	= inside diameter	ns	= nanosecond (s) = 10^{-9} seconds	sl	= slide
Al	= aluminum	impg	= impregnated	nsr	= not separately replaceable	SPDT	= single-pole double-throw
A	= ampere (s)	incd	= incandescent	Ω	= ohm (s)	SPST	= single-pole single-throw
Au	= gold	ins	= insulation (ed)	obd	= order by description	Ta	= tantalum
C	= capacitor	kΩ	= kilohm (s) = 10^{+3} ohms	OD	= outside diameter	TC	= temperature coefficient
cer	= ceramic	kHz	= kilohertz = 10^{+3} hertz	p	= peak	TiO_2	= titanium dioxide
coef	= coefficient	L	= inductor	pc	= printed circuit	tog	= toggle
com	= common	lin	= linear taper	pF	= picofarad (s) = 10^{-12} farads	tol	= tolerance
comp	= composition	log	= logarithmic taper	piv	= peak inverse voltage	trim	= trimmer
conn	= connection	m	= milli = 10^{-3}	p/o	= part of	TSTR	= transistor
dep	= deposited	mA	= milliampere (s) = 10^{-3} amperes	pos	= position (s)	V	= volt (s)
DPDT	= double-pole double-throw	MHz	= megahertz = 10^{+6} hertz	poly	= polystyrene	vacw	= alternating current working voltage
DPST	= double-pole single-throw	MΩ	= megohm (s) = 10^{+6} ohms	pot	= potentiometer	var	= variable
elect	= electrolytic	met flm	= metal film	p-p	= peak-to-peak	vdcw	= direct current working voltage
encap	= encapsulated	mfr	= manufacturer	ppm	= parts per million	W	= watt (s)
F	= farad (s)	mtg	= mounting	prec	= precision (temperature coefficient, long term stability, and/or tolerance)	w/	= with
FET	= field effect transistor	mV	= millivolt (s) = 10^{-3} volts	R	= resistor	wiv	= working inverse voltage
fxd	= fixed	μ	= micro = 10^{-6}	Rh	= rhodium	w/o	= without
GaAs	= gallium arsenide	μV	= microvolt (s) = 10^{-6} volts	rms	= root-mean-square	ww	= wirewound
GHz	= gigahertz = 10^{+9} hertz	my	= Mylar ®	rot	= rotary	*	= optimum value selected at factory, average value shown (part may be omitted)
gd	= guard (ed)	nA	= nanoampere (s) = 10^{-9} amperes	Se	= selenium	**	= no standard type number assigned (selected or special type)
Ge	= germanium	NC	= normally closed	sect	= section (s)		
grd	= ground (ed)	Ne	= neon	Si	= silicon		
H	= henry (ies)	NO	= normally open				
Hg	= mercury	NPO	= negative positive zero (zero temperature coefficient)				
Hz	= hertz (cycle (s) per second)						

® Dupont de Nemours

REV 6

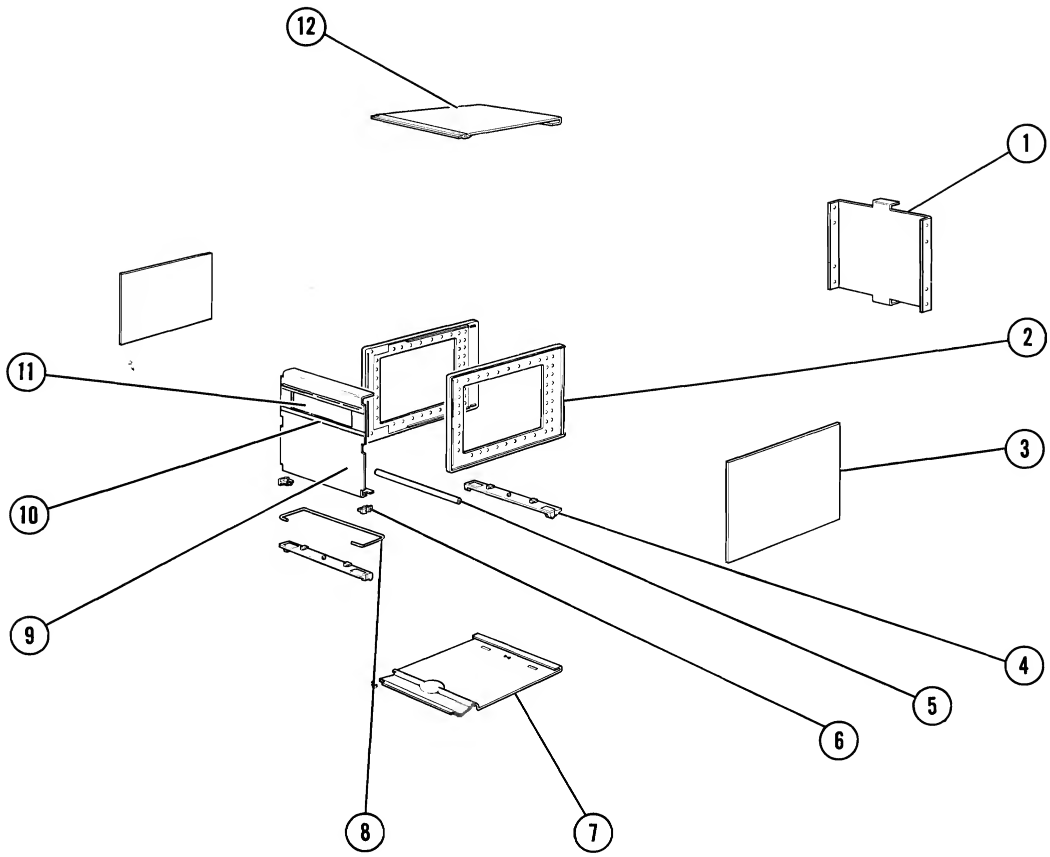
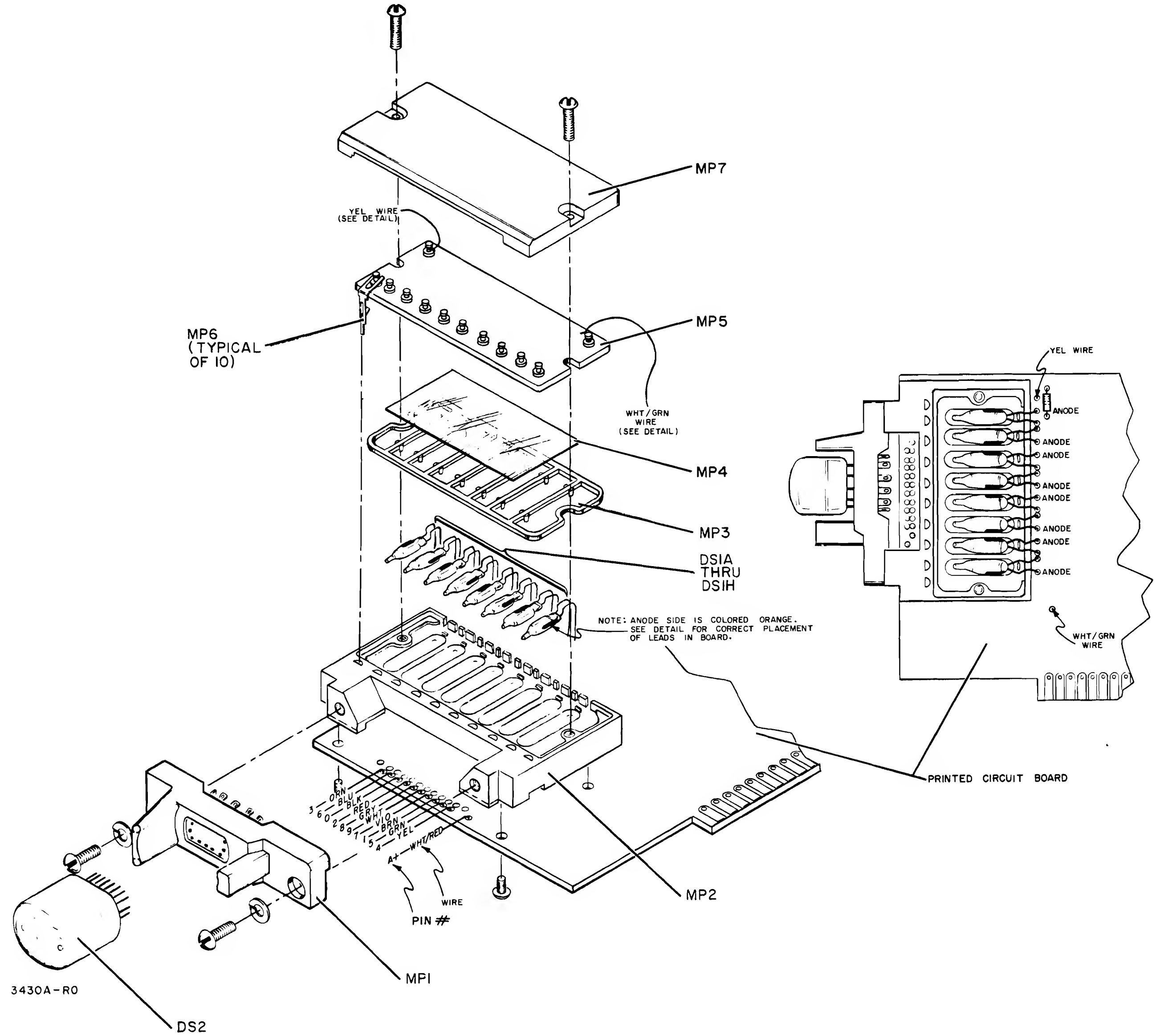


Figure 6-1. Chassis Parts

Reference	-hp- Part No.	Description	TQ	Mfr.	Mfr. Part No.
1	03430-00202	Panel rear	1	-hp-	
2	5060-0703	Frame assembly	2	-hp-	
3	5000-0703	Side Cover	2	-hp-	
	2370-0020	Screw: Phillips 3/16 in. hardware for side cover	8	83385	obd
4	5060-0728	Foot assembly	2	-hp-	
5	5020-5310	Spacer: cabinet	1	-hp-	
6	5040-0700	Hinge	2	-hp-	
7	5000-0717	Bottom cover	1	-hp-	
	2370-0016	Screw: Phillips 3/16 in. hardware for top and bottom covers	4	83385	obd
8	1490-0032	Tilt stand: half module	1	91260	obd
9	03430-00201	Front panel	1	-hp-	
10	03430-48301	Bezel: trim	1	-hp-	
11	5040-4523	Window: plexiglass	1	-hp-	
12	5060-0724	Top cover	1	-hp-	



Reference	-hp- Part No.	Description	Mfr.	Mfr. Part No.
DS1A thru DS1H	03430-88401	Lamp: neon matched set of 8	-hp-	
DS2	1970-0009	Tube: numerical indicator	83594	GA287
MP1	5060-4569	Socket: indicator tube	-hp-	
	2360-0004	Screw: hardware for MP1	80120	obd
	2190-0006	Washer: hardware for MP1	80120	obd
MP2	5040-0696	Block: photoconductor	-hp-	
	2200-0061	Screw: hardware for MP2	-hp-	
MP3	5040-4501	Gasket	-hp-	
MP4	05212-0011	Shield: transparent	-hp-	
MP5	1990-0009	Photoconductor matrix	-hp-	
MP6	1400-0283	Spring clip	-hp-	
MP7	5212A-83C	Cover	-hp-	
	2200-0006	Screw: hardware for MP7	73076	obd

Figure 6-2. Miscellaneous Parts, A2, A3, and A4 Assemblies

Table 6-1. Replaceable Parts

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
A1	**03430-66511**	**1**	**Assembly: Amplifier** Used in serial number 933-02551 and higher	**-hp-**	
	03430-66508		Assembly: Amplifier Used in serial number 723-00801 to 749-02550	-hp-	
	03430-66501		Assembly: Amplifier Used in serial number 641-00700 and below	-hp-	
C1, C2	0160-0163	2	C: fxd 0.033 microfarads 10%	56289	192P33392
C3	0160-2137	1	C: fxd my 0.27 microfarads 10% 100 vdcw	56289	148P27491
C4	0160-0938	1	C: fxd mica 1000 pF 5%	04062	RDM15E102J1C
C5			Not assigned in serial number 723-01001 and higher		
	0140-0199		C: fxd mica 240 pF 5%	72136	RDM15F241J3C
C6	0140-0176	2	C: fxd mica 100 pF 2%	04062	RDM15F101G3C
C7			Not assigned in serial number 933-02551 and higher		
	0160-0128		C: fxd cer 2.2 microfarads 20% 25 vdcw Used in serial number 723-00801 to 749-02550	56289	5C15C2
	0160-0137		C: fxd cer 0.33 microfarads 20% 25 vdcw Used in serial number 641-00700 and below	56289	5C10A75-CML
C7A, C7B	0180-0100	2	C: fxd Ta elec 4.7 microfarads 10% 35 vdcw *Added at serial number 933-02551	56289	150D475X9035B2-DYS
C8	0160-2009	1	C: fxd mica 820 pF 20%	04062	RDM15F821J3C
C9	0140-0190	1	C: fxd mica 39 pF 5%	04062	RDM15E390J3C
C10	0140-0197	1	C: fxd mica 180 pF	04062	RDM15F181J3C
C11	0170-0042	1	C: fxd my 0.33 microfarads 5% 100 vdcw	99515	obd
C12	0140-0209	1	C: fxd mica 5 pF 10% 100 vdcw	04062	RDM15C050K5C
C13	0140-0179	1	C: fxd mica 1000 pF 2%	04062	RDM19F102G3C
C14	0180-0049	1	C: fxd Al elect 20 microfarads + 75% - 10% 50 vdcw	56289	30D206G050CC2DSM
C15	0160-0362	4	C: fxd mica 510 pF 5% Used in serial number 723-01001 and higher	04062	RDM15F11J3C
C16			Not assigned in serial number 933-02551 and higher		
	0180-0393		C: fxd cer 39 microfarads 10% 10 vdcw Used in serial number 749-02550 and below	56289	30D107G003CB4
C17	0160-2212	1	C: fxd mica 560 pF 5%	04062	RDM19F561J3C
C18	0160-0174	1	C: fxd cer 0.47 microfarads + 80% - 20% 25 vdcw	56289	5C11B7
C19	0140-0208	1	C: fxd mica 680 pF 5%	04062	RDM19F561J3C
C20	0160-2605	1	C: fxd cer 0.22 microfarads - 10% + 80% 25 vdcw Added at serial number 933-02551	72982	5835Y5U203Z
CR1, CR2	1901-0156	4	Diode: Si 50 mA at + 1 V	01281	PS5553
CR3	1901-0025	46	Diode: Si 100 mA at + 1 V 100 piv 12 pF	93332	D3072
CR4			Not assigned in serial number 933-02551 and higher		
	1901-0025		Diode: Si 100 mA at + 1 V 100 piv 12 pF Used in serial number 749-02550 and below	93332	D3072
CR5 thru CR11	1901-0025		Diode: Si 100 mA at + 1 V 100 piv 12 pF	93332	D3072
J1 thru J8			Not assigned		
J9	0360-1514		Connector Used in serial number 933-02551 and higher		
	1251-0131		Connector: miniature female Used in serial number 749-02550 and below	00373	69026-1164(Red)
K1			Not assigned in serial number 933-02551 and higher		
	0490-0703		Relay: reed Used in serial number 749-02550 and below	-hp-	

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
A1 (Cont'd)					
Q1A, B	1855-0036	2	TSTR: FET dual	15818	SU2119
Q2	1854-0071	20	TSTR: Si NPN 2N3391	24446	4JX16A1014
Q3, Q4	1854-0266	4	TSTR: NPN 2N3711	01295	obd
Q5	1854-0071		TSTR: Si NPN 2N3391	24446	4JX16A1014
Q6	1853-0012	3	TSTR: Si PNP 2N2904A	04713	2N2904A
Q7, Q8	1853-0036	10	TSTR: Si PNP 2N3906	04713	SPS-3612
Q9	1854-0071		TSTR: Si NPN 2N3391	24446	4JX16A1014
Q10A, B	1854-0221	3	TSTR: Si NPN 2N4045 dual	22229	BD-1148
Q11	1854-0071		TSTR: Si NPN 2N3391	24446	4JX16A1014
Q12	1853-0036		TSTR: Si PNP 2N3906	04713	SPS-3612
Q13A, B	1854-0221		TSTR: Si NPN 2N4045 dual	22229	BD-1148
Q14	1854-0071		TSTR: Si NPN 2N3391	24446	4JX16A1014
Q15	1853-0016	10	TSTR: Si PNP 2N3638	07263	2N3638
Q16, Q17	1853-0036		TSTR: Si PNP 2N3906	04713	SPS-3612
Q18A, B	1854-0221		TSTR: Si NPN 2N4045 dual	22229	BD-1148
Q19	1854-0071		TSTR: Si NPN 2N3391	24446	4JX16A1014
Q20	1853-0069	1	TSTR: Si PNP 2N4122	07263	2N4122
Q21A, B			Not assigned in serial number 933-02551 and higher		
	1854-0221		TSTR: Si NPN 2N4045 dual Used in serial number 749-02551 and below	22229	BD-1148
Q22			Not assigned in serial number 933-02551 and higher		
	1854-0071		TSTR: Si NPN 2N3391 Used in serial number 749-02550 and below	24446	4JX16A1014
Q23			Not assigned in serial number 933-02551 and higher		
	1853-0036		TSTR: Si PNP 2N3906 Used in serial number 749-02550 and below	04713	SPS-3612
Q24, Q25	1853-0023	2	TSTR: Si PNP 2N3703	01295	obd
Q26	1854-0087	4	TSTR: Si NPN 2N3417	04713	MPS3417
Q27	1853-0036		TSTR: Si PNP 2N3906	04713	SPS-3612
Q28, Q29	1854-0087		TSTR: Si NPN 2N3417	04713	MPS3417
Q30	1854-0039	1	TSTR: Si NPN 2N3053 Added at serial number 933-02551		2N3053
Q31	1854-0087		TSTR: Si NPN 2N3417 Added at serial number 933-02551	04713	MPS3417
R1			Not assigned		
R2	0684-2241	3	R: fxd comp 220 kilohms 10% 1/4 W	01121	CB2241
R3*			See Paragraph 5-76		
R4, R5	0757-0776	2	R: fxd 110 kilohms 1% 1/4 W	19701	MF6C T-O obd
R6	0811-1789	1	R: fxd prec ww 985 ohms 0.1% 1/40 W	05347	102A obd
R7	2100-1560	2	R: var ww 30 ohms 10% 1-1/2 W	11236	110 obd
R8	0757-0064	1	R: fxd met flm 261 kilohms 1% 1/2 W	75042	CEC T-O obd
R9	0811-1794	2	R: fxd prec ww 99.25 kilohms 0.1% 1/40 W	05347	102A obd
R10	0757-0145	1	R: fxd met flm 750 kilohms 1% 1/4 W	75042	obd
R11	0683-2225	1	R: fxd 2200 ohms 5% 1/4 W	01121	CB2225
R12	0684-3331	3	R: fxd comp 33 kilohms 10% 1/4 W	01121	CB3331
R13			Not assigned in serial number 933-02551 and higher		
	0686-3925		R: fxd 3900 ohms 5% 1/2 W Used in serial number 749-02550 and below	01121	EB3925
R14*			See Paragraph 5-74		
R15, R16	0811-2411	4	R: fxd ww 16 kilohms 0.05% 1/20 W Used in serial number 943-02851 and higher	07088	KP110 obd
	0811-2397		R: fxd ww 19,955 ohms 0.25% 1/10 W Used in serial number 933-02551 to 933-02850	07088	KP110 obd
	03430-82601		R: fxd 15 kilohms 1% matched set of two Used in serial number 749-02550 and below	-hp-	
R17	2100-0282	2	R: var ww 2000 ohms 20% 1-1/2 W	71450	110 obd
R18	0698-3464	1	R: fxd met flm 1.47 megohms 1% 1/2 W	75042	CEC T-O obd

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.	
A1 (Cont'd)						
R19	0684-8221		R: fxd comp 8200 ohms 10% 1/4 W Used in serial number 933-02551 and higher	01121	CB8221	
	0684-4721		R: fxd 4700 ohms 10% 1/4 W Used in serial number 749-02550 and below	01121	CB4721	
R20	0684-1231	2	R: fxd comp 12 kilohms 10% 1/4 W	01121	CB1231	
R21	0683-2725	2	R: fxd 2.7 kilohms 5% 1/4 W	01121	CB2725	
R22	0686-4725	2	R: fxd 4700 ohms 5% 1/2 W	01121	EB4725	
R23	0684-1531	6	R: fxd 15 kilohms 10% 1/4 W	01121	CB1531	
R24	0684-2731	3	R: fxd comp 27 kilohms 10% 1/4 W	01121	CB2731	
R25	0757-0199	1	R: fxd met flm 21.5 kilohms 1% 1/8 W	000LM	obd	
R26	0698-3456	1	R: fxd met flm 287 kilohms 1% 1/8 W	19701	MF5C T-O	obd
R27, R28	0698-3160	3	R: fxd met flm 31.6 kilohms 1% 1/8 W	19701	MF5C T-O	obd
R29	0757-0123	1	R: fxd 34.8 kilohms 1% 1/8 W	75042	CEA T-O	obd
R30, R31	0811-2411		R: fxd ww 16 kilohms 0.05% 1/20 W Used in serial number 933-02551 and higher	07088	KP110	obd
	03430-82601		R: fxd 15 kilohms 1% matched set of two Used in serial number 749-02550 and below	-hp-		
R32	0698-4074	1	R: fxd met flm 1.02 megohms 1% 1/2 W	75042	CEC T-O	obd
R33			Not assigned			
R34	0757-0350	1	R: fxd met flm 909 kilohms 1% 1/4 W	75042	obd	
R35	0684-1531		R: fxd 15 kilohms 10% 1/4 W	01121	CB1531	
R36	0684-1031	3	R: fxd 10 kilohms 10% 1/4 W	01121	CB1031	
R37	0684-1531		R: fxd 15 kilohms 10% 1/4 W	01121	CB1531	
R38	0684-8231	1	R: fxd comp 82 kilohms 10% 1/4 W	01121	CB8231	
R39	0684-2731		R: fxd 27 kilohms 10% 1/4 W	01121	CB2731	
R40	0684-1061	1	R: fxd comp 10 megohms 10% 1/4 W	01121	CB1061	
R41	0684-1241	1	R: fxd 120 kilohms 10% 1/4 W	01121	CB1241	
R42	0684-1831	1	R: fxd 18 kilohms 10% 1/4 W	01121	CB1831	
R43, R44	0684-5631	5	R: fxd 56 kilohms 10% 1/4 W	01121	CB5631	
R45	0684-1541	2	R: fxd 150 kilohms 10% 1/4 W	01121	CB1541	
R46	0684-6831	5	R: fxd comp 68 kilohms 10% 1/4 W	01121	CB6831	
R47			Not assigned			
R48	0757-0871	1	R: fxd met flm 1.21 megohms 1% 1/2 W	91637	MFF 1/2 T-O	
R49	0698-5166	1	R: fxd ww 41.2 kilohms 1% 1/8 W	75042	CEA T-9	
R50*			See Paragraph 5-77			
R51	2100-2069	1	R: var comp 1000 ohms 20% 1/2 W	71450	RV5LAYSB255B	
R52	2100-0282		R: var ww 2000 ohms 20% 1-1/2 W	71450	110	obd
R53	0757-0017	1	R: fxd 1 megohm .5% 1/2 W	75042	CEC T-2	
R54	0684-1531		R: fxd 15 kilohms 10% 1/4 W	01121	CB1531	
R55	0684-5631		R: fxd 56 kilohms 10% 1/4 W	01121	CB5631	
R56	0757-0793	1	R: fxd met flm 825 kilohms 1% 1/4 W	19701	MF6C T-O	obd
R57	0684-2731		R: fxd 27 kilohms 10% 1/4 W	01121	CB2731	
R58			Not assigned in serial number 933-02551 and higher			
	0684-2231		R: fxd 22 kilohms 10% 1/4 W Used in serial number 749-02550 and below	01121	CB2231	
R59			Not assigned in serial number 933-02551 and higher			
	2100-0282		R: var ww 2000 ohms 20% 1-1/2 W Used in serial number 749-02550 and below	71450	110	obd
R60			Not assigned in serial number 933-02551 and higher			
	0698-3464		R: fxd met flm 1.47 megohms 10% 1/2 W Used in serial number 749-02550 and below	75042	CEC T-O	obd
R61			Not assigned in serial number 933-02551 and higher			
	0684-1521		R: fxd comp 1500 ohms 10% 1/4 W Used in serial number 749-02550 and below	01121	CB1521	
R62			Not assigned in serial number 933-02551 and higher			
	0757-0871		R: fxd met flm 1.21 megohms 1% 1/2 W Used in serial number 749-02550 and below	91637	MFF 1/2 T-O	obd

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
A1 (Cont'd)					
R63			Not assigned in serial number 933-02551 and higher		
	0684-1531		R: fxd 15 kilohms 10% 1/4 W Used in serial number 749-02550 and below	01121	CB1531
R64			Not assigned in serial number 933-02551 and higher		
	0684-1231		R: fxd comp 12 kilohms 10% 1/4 W Used in serial number 749-02550 and below	01121	CB1231
R65			Not assigned in serial number 933-02551 and higher		
	0686-3325		R: fxd 3300 ohms 5% 1/2 W Used in serial number 749-02550 and below	01121	EB3325
R66	0684-3931		R: fxd comp 39 kilohms 10% 1/4 W Used in serial number 933-02551 and higher	01121	CB3931
	0684-1021		R: fxd 1000 ohms 10% 1/4 W Used in serial number 749-02550 and below	01121	CB1021
R67	0684-8221	1	R: fxd 8200 ohms 10% 1/4 W	01121	CB8221
R68	0684-4721		R: fxd 4700 ohms 10% 1/4 W	01121	CB4721
R69			Not assigned in serial number 933-02551 and higher		
	0684-4711		R: fxd 470 ohms 10% 1/4 W Used in serial number 749-02550 and below	01121	CB4711
R70	0683-2725	1	R: fxd comp 2700 ohms 5% 1/4 W	01121	CB2725
R71	0757-0288	1	R: fxd met flm 9090 ohms 1% 1/8 W	000LM	obd
R72	0757-0465	2	R: fxd met flm 100 kilohms 1% 1/8 W	19701	MF5C T-O obd
R73	0698-4989	1	R: fxd met flm 1.18 megohms 1% 1/2 W	19701	MF5C T-O obd
R74	0698-3499	1	R: fxd met flm 40.2 kilohms 1% 1/8 W	75042	CEA T-O obd
R75	0698-3228	1	R: fxd met flm 49.9 kilohms 1% 1/8 W	19701	MF5C T-O obd
R76	0757-0465		R: fxd met flm 100 kilohms 1% 1/8 W	19701	MF5C T-O obd
R77, R78	0684-1531		R: fxd 15 kilohms 10% 1/4 W	01121	CB1531
R79	0684-1031		R: fxd 10 kilohms 10% 1/4 W	01121	CB1031
R80	0684-4721		R: fxd 4700 ohms 10% 1/4 W	01121	CB4721
R81	0684-1541		R: fxd 150 kilohms 10% 1/4 W	01121	CB1541
R82	0687-1021	1	R: fxd 1000 ohms 10% 1/2 W	01121	EB1021
R83	0698-4490	1	R: fxd 29.4 kilohms 5% 1/4 W	91637	MFF-1/8 T-O
R84	2100-0281	2	R: var ww single turn 100 ohms 20% 1.5 W	71450	110 obd
R85	0686-8255	1	R: fxd comp 8.2 megohms 5% 1/2 W	01121	EB8255
R86	0683-1025	1	R: fxd comp 1000 ohms 5% 1/4 W	01121	CB1025
R87	0683-2705	1	R: fxd comp 27 ohms 5% 1/4 W	01121	CB2705
R88	0683-1505	1	R: fxd comp 15 ohms 5% 1/4 W	01121	CB1505
R89	0683-4725	1	R: fxd comp 4700 ohms 5% 1/4 W	01121	CB4725
R90	0683-2215	1	R: fxd comp 220 ohms 5% 1/4 W R85 thru R90 added at serial number 723-01001	01121	CB2215
R91	0684-3931	1	R: fxd comp 39 kilohms 10% 1/4 W	01121	CB3931
R92	0684-2231	1	R: fxd comp 22 kilohms 10% 1/4 W	01121	CB2231
R93	0683-1325	1	R: fxd comp 1.3 kilohms 5% 1/4 W R91 thru R93 added at serial number 933-02551	01121	CB1325
R94	2100-0326	1	R: var ww 75 ohms 20% 1.5 W Used in serial number 943-02851 and higher	71450	110 obd
	2100-0439		R: var ww 250 ohms 20% 1.5 W Used in serial number 933-02551 to 933-02850 Not assigned in serial number 749-02550 and below	71450	110 obd
R95	0683-6225	1	R: fxd comp 6.2 kilohms 5% 1/4 W Added at serial number 933-02551	01121	CB6225
A2	**03430-66502**	**1**	**Assembly: Hundreds Decade Counter**	**-hp-**	
A1 thru A5	1810-0005	13	Resistive network: 12 met flm	71590	obd
A6	1810-0006	3	Resistive network: 10 270 kilohms 10%	56289	obd

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
A2 (Cont'd)					
C1	0140-0218	2	C: fxd mica 160 pF 2%	04062	RDM15F161G3C
C2	0140-0217	5	C: fxd mica 140 pF 2%	04062	RDM15F141G3C
C3	0140-0194	8	C: fxd mica 110 pF 5%	04062	RDM15F111J3C
C4	0140-0217		C: fxd mica 140 pF 2%	04062	RDM15F141G3C
C5, C6	0140-0198	17	C: fxd mica 200 pF 5%	04062	RDM15F201J3C
C7	0160-0134	1	C: fxd mica 220 pF 5%	14655	RDM15F221J3C
C8	0140-0194		C: fxd mica 110 pF 5%	04062	RDM15F111J3C
C9*			See Paragraph 5-77		
C10	0140-0195	3	C: fxd mica 130 pF 5%	04062	RDM15F131J3C
C11, C12	0140-0198		C: fxd mica 200 pF 5%	04062	RDM15F201J3C
C13	0160-0362		C: fxd mica 510 pF 5%	04062	RDM15F511J3C
C14 thru C16	0140-0198		C: fxd mica 200 pF 5%	04062	RDM15F201J3C
C17	0160-0168	2	C: fxd 0.1 microfarads 10%	56289	192P10492
CR1 thru CR8	1901-0025		Diode: Si 100 mA at + 1 V 100 piv 12 pF	93332	D3072
CR9 thru CR14	1910-0016	14	Diode: Ge	03877	S3185G
CR15 thru CR20	1910-0025		Diode: Si 100 mA at +1 V 100 piv 12 pF	93332	D3072
DS1A thru DS1H	03430-88401	24	Lamp: neon matched set of 8	-hp-	
DS2	1970-0009	3	Tube: special purpose 10 digit numeral indicator	83594	B5991
Q1 thru Q8	1850-0062	26	TSTR: Ge special 2N404	01295	GA287
Q9 thru Q15	1853-0016		TSTR: Si PNP 2N3638	07263	2N3638
Q16 thru Q19	1854-0071		TSTR: Si NPN 2N3391	24446	4JX16A1014
Q20, Q21	1850-0062		TSTR: Ge special 2N404	01295	GA287
Q22	1853-0036		TSTR: Si PNP 2N3906	04713	2N3906
Q23	1853-0016		TSTR: Si PNP 2N3638	07263	2N3638
Q24	1854-0071		TSTR: Si NPN 2N3391	24446	4JX16A1014
Q25	1853-0016		TSTR: Si PNP 2N3638	07263	2N3638
Q26	1854-0022	3	TSTR: Si NPN**	-hp-	
Q27	1854-0071		TSTR: Si NPN 2N3391	24446	4JX16A1014
R1	0683-1845	1	R: fxd comp 180 kilohms 5% 1/4 W	01121	CB1845
R2	0698-5143	1	R: fxd met flm 395 kilohms 0.25% 1/8 W	75042	CEA T-2
R3	0683-7535	3	R: fxd 75 kilohms 5% 1/4 W	01121	CB7535
R4	2100-0356	2	R: var ww 3000 ohms 10% 1-1/2 W	71450	110 obd
R5	0684-3331		R: fxd comp 33 kilohms 10% 1/4 W	01121	CB3331
R6	2100-0330	2	R: var ww 1500 ohms 10% 1-1/2 W	71450	110 obd
R7	0683-7535		R: fxd 75 kilohms 5% 1/4 W	01121	CB7535
R8	2100-0356		R: var ww 3000 ohms 10% 1-1/2 W	71450	110 obd
R9	0698-5170	2	R: fxd met flm 198.5 kilohms 0.5% 1/8 W	75042	CEA T-2
R10	0684-5631		R: fxd 56 kilohms 10% 1/4 W	01121	CB5631
R11	0683-1045	2	R: fxd comp 100 kilohms 5% 1/4 W	01121	CB1045
R12	0811-1794		R: fxd ww 99.25 kilohms 0.1% 1/40 W	05347	102A
R13	0684-6831		R: fxd comp 68 kilohms 10% 1/4 W	01121	CB6831
R14	0683-5135	1	R: fxd 51 kilohms 5% 1/4 W	01121	CB5135
R15	0698-5170		R: fxd met flm 198.5 kilohms 0.5% 1/8 W	75042	CEA T-2
R16	0684-5631		R: fxd 56 kilohms 10% 1/4 W	01121	CB5631
R17	0683-1045		R: fxd comp 100 kilohms 5% 1/4 W	01121	CB1045
R18 thru R21	0684-3941	12	R: fxd 390 kilohms 10% 1/4 W	01121	CB3941
R22	0687-4731	3	R: fxd 47 kilohms 10% 1/2 W	01121	EB4731
R23, R24	0683-8225	6	R: fxd 8200 ohms 5% 1/4 W	01121	CB8225
R25	0684-6831		R: fxd comp 68 kilohms 10% 1/4 W	01121	CB6831
R26	0683-6845	1	R: fxd 680 kilohms 5% 1/4 W	01121	CB6845
R27	0683-2745	1	R: fxd comp 270 kilohms 5% 1/4 W	01121	CB2745
R28	0686-2445	1	R: fxd 240 kilohms 5% 1/2 W	01121	EB2445
R29	0683-5145	1	R: fxd 510 kilohms 5% 1/4 W	01121	CB5145

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
A2 (Cont'd)					
R30, R31	0683-1835	2	R: fxd 18 kilohms 5% 1/4 W	01121	CB1835
R32	0683-7535		R: fxd 75 kilohms 5% 1/4 W	01121	CB7535
R33	0684-1231		R: fxd comp 12 kilohms 10% 1/4 W	01121	CB1231
R34	0683-3035	1	R: fxd 30 kilohms 5% 1/4 W	01121	CB3035
R35	0811-1792	1	R: fxd ww 66.2 kilohms 0.1% 1/2 W	05347	102A
R36	2100-0330		R: var ww 1500 ohms 10% 1-1/2 W	71450	110 obd
R37	0684-3331		R: fxd comp 33 kilohms 10% 1/4 W	01121	CB3331
R38	0683-1835		R: fxd 18 kilohms 5% 1/4 W	01121	CB1835
R39	2100-0396	2	R: var ww 10 kilohms 20% 1-1/2 W	71450	110 obd
S1	3101-0961	1	Switch: slide TEST/OPERATE	79727	G-124-PC
MP1	5040-4569	3	Socket: indicator tube	-hp-	
MP2	5040-0696	3	Block: photoconductor	-hp-	
MP3	5040-4501	3	Gasket: photoconductor block	-hp-	
MP4	05212-0011	3	Shield: transparent	-hp-	
MP5	1990-0009	3	Plate: photoconductor matrix	-hp-	
MP6	1400-0283	30	Spring Clip	-hp-	
MP7	5212A-83C	3	Cover	-hp-	
A3	**03430-66503**	**1**	**Assembly: Tens Decade**	**-hp-**	
A1 thru A4	1810-0005		Resistive network: 12 met flm	71590	obd
A5	1810-0006		Resistive network: 10 270 kilohms 10%	56289	obd
C1	0140-0218		C: fxd mica 160 pF 2%	04062	RDM15F161G3C
C2	0140-0217		C: fxd mica 140 pF 2%	04062	RDM15F141G3C
C3	0140-0194		C: fxd mica 110 pF 5%	04062	RDM15F111J3C
C4	0140-0176		C: fxd mica 100 pF 2%	04062	RDM15F101G3C
C5 thru C7	0140-0198		C: fxd mica 200 pF 5%	04062	RDM15F201J3C
C8, C9	0140-0194		C: fxd mica 110 pF 5%	04062	RDM15F111J3C
C10	0140-0195		C: fxd mica 130 pF 5%	04062	RDM15F131J3C
C11, C12	0140-0198		C: fxd mica 200 pF 5%	04062	RDM15F201J3C
C13	0160-0362		C: fxd mica 510 pF 5%	04062	RDM15F241J3C
CR1 thru CR8	1901-0025		Diode: Si 100 mA at + 1 V 100 piv 12 pF	93332	D3072
CR9 thru CR12	1910-0016		Diode: Ge	03877	S3185G
DS1A thru DS1H	03430-88401		Lamp: neon matched set of 8	-hp-	
DS2	1970-0009		Tube: special purpose 10 digit numeral indicator	83594	B5991
Q1 thru Q8	1850-0062		TSTR: Ge special 2N404	01295	GA287
Q9 thru Q12	03430-82501	8	TSTR: low leakage	-hp-	
R1	0684-1041	8	R: fxd 100 kilohms 10% 1/4 W	01121	CB1041
R2	0727-0849	2	R: fxd 2 megohms 1% 1/2 W	75042	CEA T-O obd
R3	0684-1041		R: fxd 100 kilohms 10% 1/4 W	01121	CB1041
R4	0698-5159	4	R: fxd met flm 1 megohm 0.5% 1/4 W	75042	CEA T-O obd
R5	0684-1041		R: fxd 100 kilohms 10% 1/4 W	01121	CB1041
R6	0698-5157	2	R: fxd met flm 500 kilohms 0.25% 1/4 W	75042	CEA T-O obd
R7	0684-1041		R: fxd 100 kilohms 10% 1/4 W	01121	CB1041

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
A3 (Cont'd)					
R8	0698-5159		R: fxd met flm 1 megohm 0.5% 1/4 W	75042	CEA T-O obd
R9	0683-1125	2	R: fxd 1100 ohms 5% 1/4 W	01121	CB1125
R10	0727-0849		R: fxd 2 megohms 1% 1/2 W	75042	CEA T-O obd
R11	0698-5159		R: fxd met flm 1 megohm 0.5% 1/4 W	75042	CEA T-O obd
R12	0698-5157		R: fxd met flm 500 kilohms 0.25% 1/4 W	75042	CEA T-O obd
R13	0698-5159		R: fxd met flm 1 megohm 0.5% 1/4 W	75042	CEA T-O obd
R14	0684-0271	4	R: fxd 2.7 ohms 10% 1/4 W	01121	CB27G1
R15 thru R18	0684-3941		R: fxd 390 kilohms 10% 1/4 W	01121	CB3941
R19	0687-4731		R: fxd 47 kilohms 10% 1/2 W	01121	EB4731
R20, R21	0683-8225		R: fxd 8200 ohms 5% 1/4 W	01121	CB8225
R22	0684-6831		R: fxd comp 68 kilohms 10% 1/4 W	01121	CB6831
MP1	5040-4569		Socket: indicator tube	-hp-	
MP2	5040-0696		Block: photoconductor	-hp-	
MP3	5040-4501		Gasket: photoconductor block	-hp-	
MP4	05212-0011		Shield: transparent	-hp-	
MP5	1990-0009		Plate: photoconductor matrix	-hp-	
MP6	1400-0283		Spring Clip	-hp-	
MP7	5212A-83C		Cover	-hp-	
A4	**03430-66504**	**1**	**Assembly: Units Decade**	**-hp-**	
A1 thru A4	1810-0005		Resistive network: 12 met flm	71590	obd
A5	1810-0006		Resistive network: 10 270 kilohms 10%	56289	obd
C1	0140-0194		C: fxd mica 110 pF 5%	04062	RDM15F111J3C
C2	0140-0217		C: fxd mica 140 pF 2%	04062	RDM15F141G3C
C3	0140-0194		C: fxd mica 110 pF 5%	04062	RDM15F111J3C
C4	0140-0217		C: fxd mica 140 pF 2%	04062	RDM15F141G3C
C5 thru C7	0140-0198		C: fxd mica 200 pF 5%	04062	RDM15F201J3C
C8, C9	0140-0194		C: fxd mica 110 pF 5%	04062	RDM15F111J3C
C10	0140-0195		C: fxd 130 pF	04062	RDM15F131J3C
C11, C12	0140-0198		C: fxd mica 200 pF 5%	04062	RDM15F201J3C
C13	0160-0362		C: fxd mica 510 pF 5%	04062	RDM15F511J3C
CR1 thru CR8	1901-0025		Diode: Si 100 mA at + 1 V 100 piv 12 pF	93332	D3072
CR9 thru CR12	1910-0016		Diode: Ge	03877	S3185G
DS1A thru DS1H	03430-84401		Lamp: neon matched set of 8	-hp-	
DS2	1970-0009		Tube: special purpose 10 digit numeral indicator	83594	B5991
Q1 thru Q8	1850-0062		TSTR: Ge special 2N404	01295	GA287
Q9 thru Q12	03430-82501		TSTR: low leakage	-hp-	
R1	0684-1041		R: fxd 100 kilohms 10% 1/4 W	01121	CB1041
R2	0683-2055		R: fxd comp 2 megohms 5% 1/4 W	01121	CB2055
R3	0684-1041		R: fxd 100 kilohms 10% 1/4 W	01121	CB1041
R4	0683-1055	4	R: fxd 1 megohm 5% 1/4 W	01121	CB1055
R5	0684-1041		R: fxd 100 kilohms 10% 1/4 W	01121	CB1041

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
A4 (Cont'd)					
R6	0757-0327	2	R: fxd met flm 499 kilohms 1% 1/4 W	75042	obd
R7	0684-1041		R: fxd 100 kilohms 10% 1/4 W	01121	CB1041
R8	0683-1055		R: fxd 1 megohm 5% 1/4 W	01121	CB1055
R9	0683-1125		R: fxd 1100 ohms 5% 1/4 W	01121	CB1125
R10	0683-2055		R: fxd 2 megohms 5% 1/4 W	01121	CB2055
R11	0683-1055		R: fxd 1 megohm 5% 1/4 W	01121	CB1055
R12	0757-0327		R: fxd met flm 499 kilohms 1% 1/4 W	75042	CEC T-O obd
R13	0683-1055		R: fxd 1 megohm 5% 1/4 W	01121	CB1055
R14	0684-0271		R: fxd 2.7 ohms 10% 1/4 W	01121	CB27G1
R15 thru R18	0684-3941		R: fxd 390 kilohms 10% 1/4 W	01121	CB3941
R19	0687-4731		R: fxd 47 kilohms 10% 1/2 W	01121	EB4731
R20, R21	0683-8225		R: fxd 8200 ohms 5% 1/4 W	01121	CB8225
R22	0684-6831		R: fxd comp 68 kilohms 10% 1/4 W	01121	CB6831
R23	0698-0025	1	R: fxd met flm 17.8 kilohms 1% 1/2 W	000LM	obd
R24	0757-0824	1	R: fxd met flm 2000 ohms 1% 1/2 W	75042	CEC T-O obd
MP1	5040-4569		Socket: indicator tube	-hp-	
MP2	5040-0696		Block: photoconductor	-hp-	
MP3	5040-4501		Gasket: photoconductor block	-hp-	
MP4	05212-0011		Shield: transparent	-hp-	
MP5	1990-0009		Plate: photoconductor matrix	-hp-	
MP6	1400-0283		Spring Clip	-hp-	
MP7	5212A-83C		Cover	-hp-	
A5	**03430-66505**	**1**	**Assembly: Regulator**	**-hp-**	
C1	0180-0050	1	C: fxd Al elect 40 microfarads + 100% - 15% 50 vdcw	56289	30D406G050DF6M1
C2			Not assigned		
C3	0180-0039	1	C: fxd Al elect 100 microfarads + 75% - 10% 12 vdcw	56289	30D107G012CC2-DSM
C4	0180-0094	1	C: fxd Al elect 100 microfarads + 75% - 10% 25 vdcw	56289	30D107G025DD2-DSM
C5	0170-0038	1	C: fxd my 0.22 microfarads 10% 200 vdcw	56289	148P22492
C6	0160-0945	2	C: fxd mica 910 pF 5%	04062	RDM15F911J1C
C7	0160-0154	2	C: fxd my 0.0022 microfarads 10% 200 vdcw	56289	192P22292-PTS
C8	0160-0945		C: fxd mica 910 pF 5%	04062	RDM15F911J1C
C9	0160-0154		C: fxd my 0.0022 microfarads 10% 200 vdcw	56289	192P22292-PTS
CR1 thru CR6	1901-0025		Diode: Si 100 mA at + 1 V 100 piv 12 pF	93332	D3072
CR7	1902-0071	1	Diode: Si breakdown 9.0 V 5%	04713	obd
CR8	1902-0556	1	Diode: breakdown 20.0 V 5%	75042	obd
CR9 thru CR12	1901-0029	4	Diode: Si 600 piv	04713	SR1358-10
CR13 thru CR18	1901-0158	6	Diode: Si 200 piv	04713	SR1358-3
Q1	1854-0090	1	TSTR: Si NPN	04713	SM8158
Q2, Q3	1853-0012		TSTR: Si PNP 2N2904A	04713	2N2904A
Q4, Q5			Not assigned		
Q6	1853-0001	1	TSTR: Si PNP**	-hp-	
Q7, Q8	1854-0071		TSTR: Si NPN 2N3391	24446	4JX16A1014
Q9	1853-0036		TSTR: Si PNP 2N3906	04713	SPS-3612
Q10, Q11	1854-0022		TSTR: **	-hp-	
Q12	1853-0036		TSTR: Si PNP 2N3906	04713	SPS-3612
Q13, Q14	1854-0071		TSTR: Si NPN 2N3391	24446	4JX16A1014

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
A5 (Cont'd)					
R1	0684-0271		R: fxd 2.7 ohms 10% 1/4 W	01121	CB27G1
R2	0684-2241		R: fxd comp 220 kilohms 10% 1/4 W	01121	CB2241
R3	0698-4892	1	R: fxd met flm 1.87 kilohms 1% 1/2 W	75042	CEA T-O obd
R4	0698-0026	1	R: fxd met ox 1690 ohms 5% 1/2 W	19701	MF7C T-O obd
R5	0698-4657	1	R: fxd met flm 7150 ohms 1% 1/4 W	19701	MF6C T-O obd
R6			Not assigned		
R7	0698-4898	1	R: fxd 2800 ohms 1% 1/2 W	91637	MFF-1/2 T-O obd
R8 thru R10			Not assigned		
R11	0683-0335	2	R: fxd comp 3.3 ohms 5% 1/4 W	01121	CB33G5
R12	0698-4652	1	R: fxd met flm 5760 ohms 1% 1/4 W	19701	MF6C T-O obd
R13	0757-0739	1	R: fxd 2000 ohms 1% 1/4 W	19701	MF6C T-O obd
R14			Not assigned		
R15	0698-3346	1	R: fxd met flm 4220 ohms 1% 1/2 W	75042	CEC T-O obd
R16	0684-5601	1	R: fxd 56 ohms 10% 1/4 W	01121	CB5601
R17	0684-1031		R: fxd 10 kilohms 10% 1/4 W	01121	CB1031
R18	0757-0782	1	R: fxd met flm 200 kilohms 1% 1/4 W	19701	MF6C T-O obd
R19	0757-0341	1	R: fxd met flm 30.1 kilohms 1% 1/4 W	19701	MF6C T-O obd
R20	2100-0290		R: var ww 100 ohms 20% 1.5 W Used in serial number 749-02151 and above	71450	110 obd
	2100-0328		R: var ww 500 ohms 10% 1-1/2 W Used in serial number 749-02150 and below	71450	110 obd
R21	0698-4702	1	R: fxd met flm 8450 ohms 1% 1/4 W	91637	MFF-1/4 T-O obd
R22	0764-0015	1	R: fxd 560 ohms 5% 2 W	07115	C-42S obd
R23	0757-0464	1	R: fxd 90.9 kilohms 1% 1/8 W	19701	MF7C T-9
R24	0698-4735	1	R: fxd met flm 34.0 kilohms 1% 1/4 W	91637	MFF-1/4 T-O obd
R25			Not assigned		
R26	0698-4036	1	R: fxd met flm 16.9 kilohms 1% 1/4 W	19701	MF6C T-O obd
R27	0684-0271		R: fxd 2.7 ohms 10% 1/4 W	01121	CB27G1
R28	0683-0335		R: fxd comp 3.3 ohms 5% 1/4 W	01121	CB33G5
R29*			See Paragraph 5-79 Added at serial number 749-02151		
MP1	1205-0033	2	Heat sink: semiconductor used with A5Q1 and A5Q6	05820	NF-207
A6	**03430-66506**	**1**	**Assembly: Attenuator**	**-hp-**	
R1	0727-0262	1	R: fxd prec 900 kilohms 0.5% 1/2 W	91637	DCS1/2
R2	03430-82602	1	R: fxd met flm 8.94 megohms 0.25% 1 W	-hp-	
R3*			See Paragraph 5-75		
R4	2100-0396		R: var ww 10 kilohms 20% 1-1/2 W	71450	110 obd
R5	0698-5158	1	R: fxd 894 kilohms 1% 1/4 W	75042	CEC T-9
R6	2100-0282		R: var ww 2000 ohms 20% 1-1/2 W	71450	110 obd
R7	0683-8245	1	R: fxd 820 kilohms 5% 1/4 W	01121	CB8245
R8	0811-1793	1	R: fxd ww 88.9 kilohms 0.1%	05347	102A obd
R9	2100-0439	1	R: var ww 250 ohms 20% 1-1/2 W	71450	110 obd
R10	0683-9145	2	R: fxd 910 kilohms 5% 1/4 W	01121	CB9145
R11	0811-1790	1	R: fxd ww 8860 ohms 1%	05347	102A obd
R12	2100-1560		R: var ww 30 ohms 10% 1-1/2 W	11236	110 obd
R13	0683-9145		R: fxd 910 kilohms 5% 1/4 W	01121	CB9145
R14	0811-1789		R: fxd prec ww 985 ohms 0.1% 1/2 W	05347	102A obd
A7	**03430-66507**	**1**	**Assembly: Ratio (Option 01 only)**	**-hp-**	
C1	0160-0194	1	C: fxd my 0.015 microfarad 10% 200 vdcw	56289	192P15392-PTS
C2			Not assigned		

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
A7 (Cont'd)					
C3	0160-0166	1	C: fxd my 0.068 microfarads 10% 200 vdcw	56289	192P68392-PTS
C4	0160-0168		C: fxd 0.1 microfarads 10%	56289	192P10492-PTS
CR1, CR2	1901-0156		Diode: Si 50 mA at + 1 V 20 wiv	01281	PS5553
CR3	1901-0025		Diode: Si 100 mA at + 1 V 100 piv 12 pF	93332	D3072
Q1A, B	1855-0036		TSTR: F.E.T. dual	15818	SU2119
Q2	1854-0071		TSTR: Si NPN 2N3391	24446	4JX16A1014
Q3, Q4	1854-0266		TSTR: NPN 2N3711	01295	obd
Q5	1854-0071		TSTR: Si NPN 2N3391	24446	4JX16A1014
Q6	1853-0036		TSTR: Si PNP 2N3906	04713	2N3906
R1	0757-0482	1	R: fxd met flm 511 kilohms 1% 1/8 W	000LM	obd
R2	0684-2241		R: fxd comp 220 kilohms 10% 1/4 W	01121	CB2241
R3	0757-0438	1	R: fxd met flm 5.11 kilohms 1% 1/8 W	75042	CEA T-O obd
R4	2100-0356		R: var ww 3000 ohms 10% 1-1/2 W	71450	110 obd
R5	0698-5450	1	R: fxd met flm 50 kilohms 0.1% 1/8 W	75042	CEA T-O obd
R6	0698-3457	1	R: fxd met flm 316 kilohms 1% 1/8 W	000LM	obd
R7	0698-3159	1	R: fxd met flm 26.1 kilohms 1% 1/8 W	000LM	obd
R8	0757-0274	1	R: fxd met flm 1210 ohms 1% 1/8 W	000LM	obd
R9, R10	0757-0466	3	R: fxd met flm 110 kilohms 1% 1/8 W	19701	MF5C T-O obd
R11	2100-0281	1	R: var ww single turn 100 ohms 20% 1-1/2 W	11237	110 obd
R12*			See Paragraph 5-78		
R13, R14	0698-3260	2	R: fxd met flm 464 kilohms 1% 1/8 W	19701	MF5C T-O obd
R15	0757-0466		R: fxd met flm 110 kilohms 1% 1/8 W	19701	MF5C T-O obd
R16	0698-3160		R: fxd met flm 31.6 kilohms 1% 1/8 W	19701	MF5C T-O obd
R17	0757-0441	1	R: fxd met flm 8250 ohms 1% 1/8 W	19701	MF5C T-O obd
R18	0698-5171	1	R: fxd met flm 400 kilohms 0.1% 1/8 W	75042	CEA T-O obd
R19*			See Paragraph 5-79		
R20	2100-0396		R: var ww 10 kilohms 20% 1-1/2 W	71450	110 obd
R21	0686-4725		R: fxd 4700 ohms 5% 1/2 W	01121	EB4725
R22	0757-0395	1	R: fxd met flm 56.2 ohms 1/8 W	91637	MFF-1/8 T-O obd
R23	0686-1505	1	R: fxd comp 15 ohms 5% 1/2 W	01121	EB1505
R24	0757-0458	1	R: fxd met flm 51.1 kilohms 1% 1/8 W	91637	MFF-1/8 T-O obd
C1, C2	0180-0107	2	C: fxd 20 microfarads + 100% - 10% 200 vdcw	56289	D34154
C3	0180-0148	1	C: fxd 890 microfarads + 100% - 10% 15 vdcw	56289	D37921
C4	0180-0056	1	C: fxd 1000 microfarads 50 vdcw	56289	D32429
C5	0180-0353	1	C: fxd 450 microfarads + 100% - 10% 50 vdcw	56289	D38702
C6	0170-0022	1	C: fxd my 0.1 microfarads 20% 600 vdcw	000LH	HEW-17
CR1	1901-0025		Diode: Si 100 mA at + 1 V 100 piv 12 pF	93332	D3072
DS1, DS2	2140-0015	4	Lamp: glow neon	24446	NE2E4 obd
DS3 thru DS5	2140-0028	3	Lamp: glow neon	24446	NE2E4 obd
DS6, DS7	2140-0073	2	Lamp: incandescent	71744	CM8-627
DS8	2140-0015		Lamp: glow neon OVERRANGE	24446	NE2E4 obd
DS9	2140-0015		Lamp: glow neon RATIO (Option 01 only)	24446	NE2E4 obd
F1	2110-0044	1	Fuse: cartridge 0.3 amp slow-blow	75915	313.300
J1	1251-1450	4	Connector: 22 pin female connector for A1	95354	178-100-07
J2	1251-1451	1	Connector: 22 pin female connector for A2	95354	176-100-07

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
J3 thru J5	1251-1450		Connector: 22 pin female connector for A3, A4 and A5	95354	178-100-07
J6			Terminal Set: INPUT, see MP1, MP2, MP5		
J7	1251-1450		Connector: 22 pin female connector for A7 (Option 01 only)	95354	178-100-07
J8			Terminal Set: AMPLIFIER OUTPUT and RATIO INPUT		
R1, R2	0686-4735	3	R: fxd 47 kilohms 5% 1/2 W	01121	EB4735
R3			Not assigned in serial number 933-02551 and higher		
	0757-0818		R: fxd 825 ohms 1% 1/2 W Used in serial number 749-02550 and below	75042	CEC T-O obd
R4	2100-2034	1	R: var lin ww ten turn 10 ohms 10%	71450	VA-45
R5	0698-3635	1	R: fxd comp 680 ohms 5% 2 W Used in serial number 933-02551 and higher	14674	C-425
	0767-0001		R: fxd 400 ohms 5% 3 W Used in serial number 749-02550 and below	07115	LP1-3
R6, R7	0687-1041	2	R: fxd 100 kilohms 10% 1/2 W	01121	EB1041
R8	0686-4735		R: fxd comp 47 kilohms 5% 1/2 W (Option 01 only)	01121	CB4735
R9	0687-3931	1	R: fxd comp 39 kilohms 10% 1/2 W	01121	EB3931
S1	3100-1736	1	Switch: rotary, RANGE	76854	obd
S2	3101-0001	1	Switch: SPST toggle	04009	80994-HB
S3	3101-0033	1	Switch: 115/230 slide SPDT miniature	82389	11A-1009
S4, S5	3101-0070	2	Switch: slide DPDT miniature (Option 01 only)	79727	G-126
T1	9100-1339	1	Transformer: power	-hp-	
XF1	1400-0084	1	Holder: fuse	75915	342014
			MISCELLANEOUS PARTS SEE FIGURE 6-3		
MP1	1510-0008	3	Binding post assembly: red	-hp-	
MP2	1510-0009	2	Binding post assembly: black w/o solder turret	-hp-	
MP3	7100-0120	1	Cover: half shell	04842	Size 1 Std. H
MP4	5060-0625	1	Binding post: black	-hp-	
MP5	5040-4563	1	Hold down bar	-hp-	
	2460-0028	1	Screw: Phillips 9/16 in.(for hold down bar)	80120	obd
	2190-0006	1	Lock washer: (for hold down bar)	80120	obd
	3050-0010	1	Flat washer: (for hold down bar)	000LI	obd
MP6	5020-5309	1	Retainer	-hp-	
MP7	03430-01202	1	Bracket	-hp-	
MP8	5040-4510	1	Annunciator and Decimal Holder	-hp-	
MP9			Not assigned		
MP10	5040-0695	1	Readout block: digit	-hp-	
MP11, MP12			Not assigned		
MP13	5040-0693	1	Insert: digit readout	-hp-	
MP14	5020-0687	1	Polarity readout	-hp-	
MP15	5000-2839	6	Partition: annunciator	-hp-	
MP16	03430-24301	1	Function readout	-hp-	
MP17	0340-0038	5	Post: terminal	00866	HP-3000 M-3
MP18	0340-0039	11	Insulator: bushing	00866	HP-3000 T-1
MP19	0340-0037	6	Post: terminal-turret	98291	X-L041762-9

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
			MISC PARTS (Cont'd)		
MP20	1520-0002	1	Plate: mounting	56137	obd
MP21	1520-0001	1	Plate: mounting	56137	Grade X-831
MP22	1520-0003	3	Plate: mounting	37942	obd
MP23	0370-0112	1	Knob: black w/one arrow p/o S1	-hp-	
MP24	1251-0148	1	Connector: power 3 female contacts	71468	MS3102R14S7S(c)
MP25	8120-0078	1	Cord set: power	70903	KH-4147
MP26	03430-90002	1	Manual: Operating and Service	-hp-	

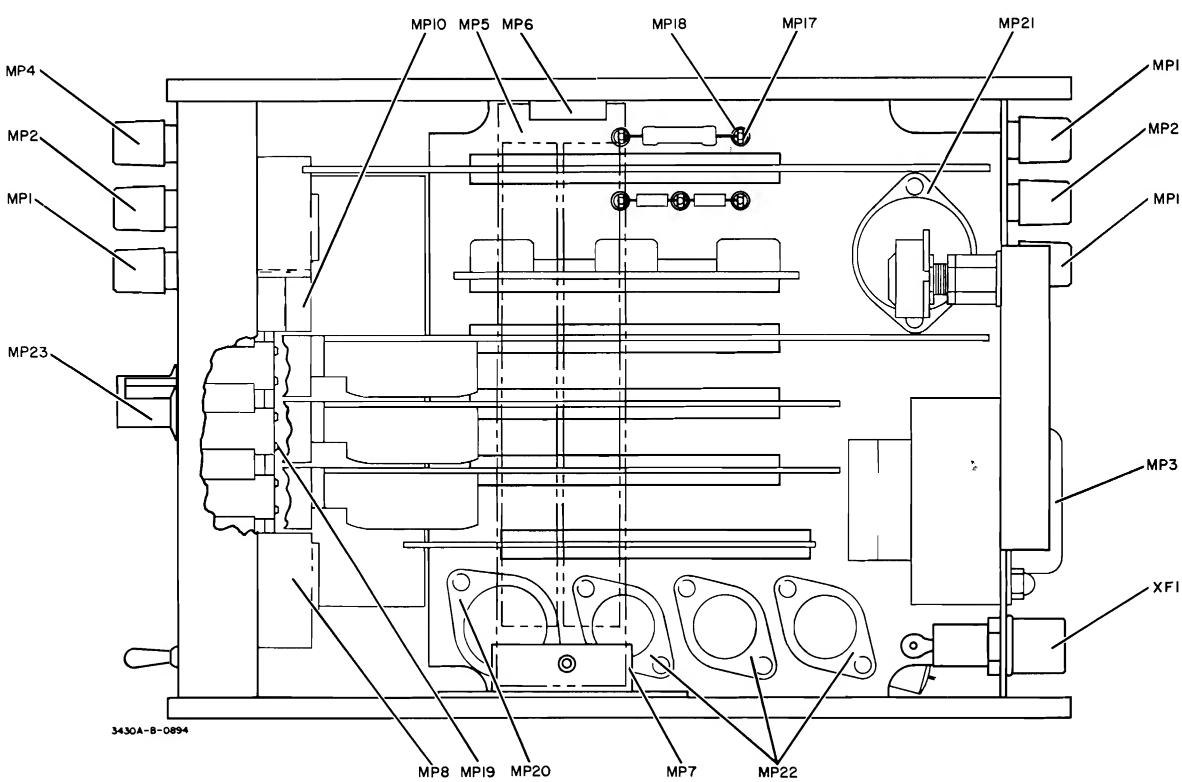


Figure 6-3. Miscellaneous Chassis Parts

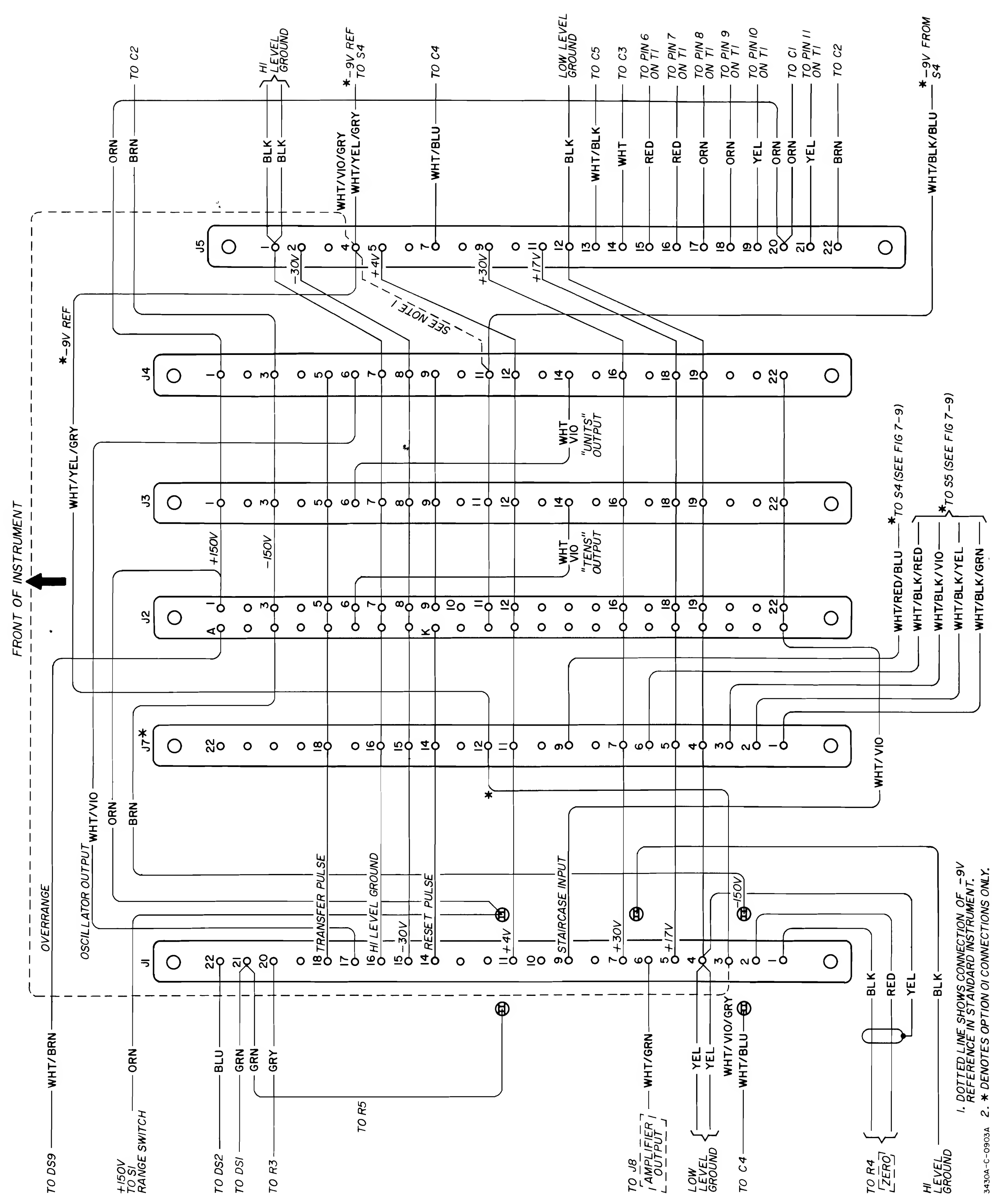


Figure 7-1A. Wiring Diagram

SECTION VII
CIRCUIT DIAGRAMS

7-1. INTRODUCTION.

7-2. This section contains the diagrams necessary to maintain the Model 3430A. Both pictorial views of the circuit boards, and schematic diagrams are included. Figure 7-1A is a wiring diagram, and 7-1B shows the location of circuit boards and chassis mounted components. Figure 7-2 contains a block diagram. Figure 7-3A applies to instruments with serial numbers 723-01001 and above. Figure 7-3B applies to instruments with serial numbers 723-01000 and below and instruments with serial numbers prefixed 641-.

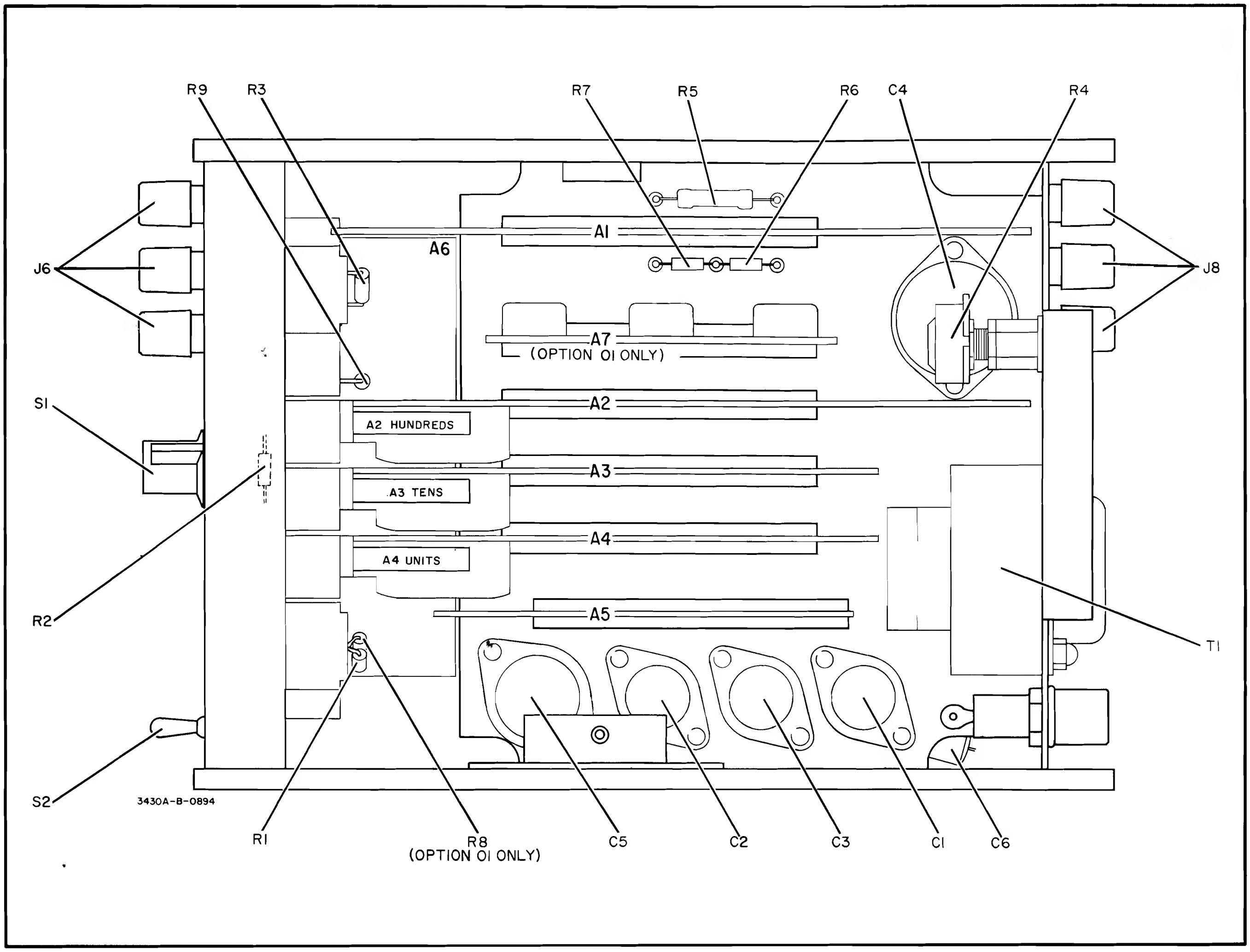
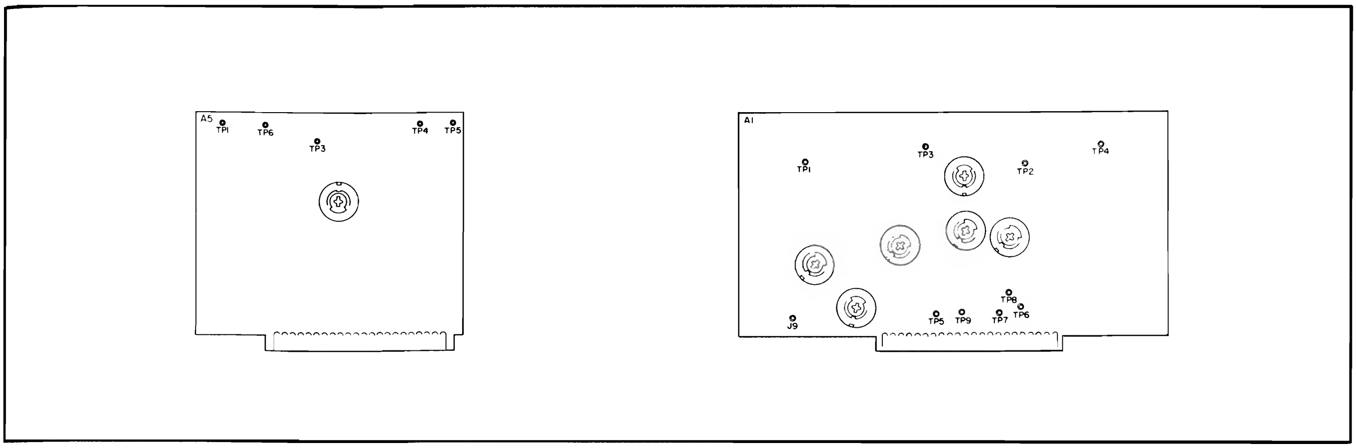


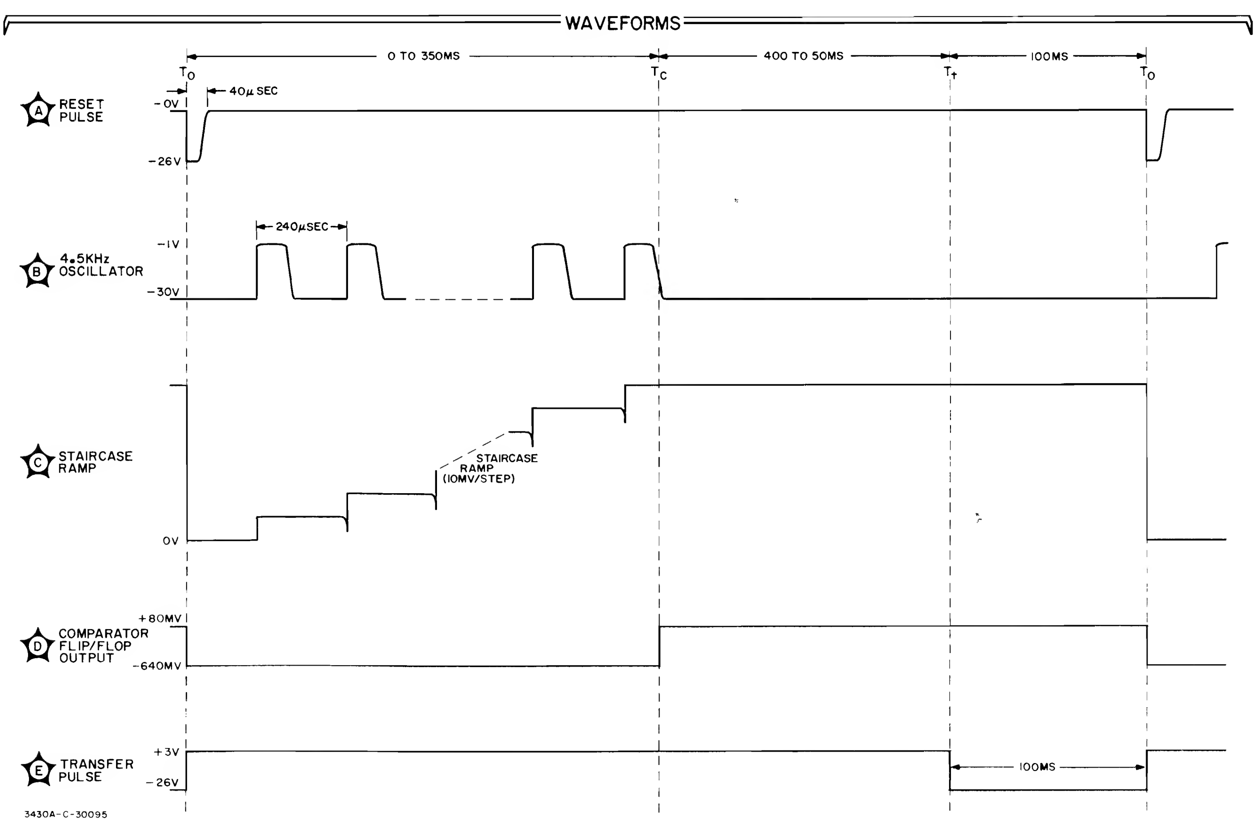
Figure 7-1B. Location of Chassis Mounted Components

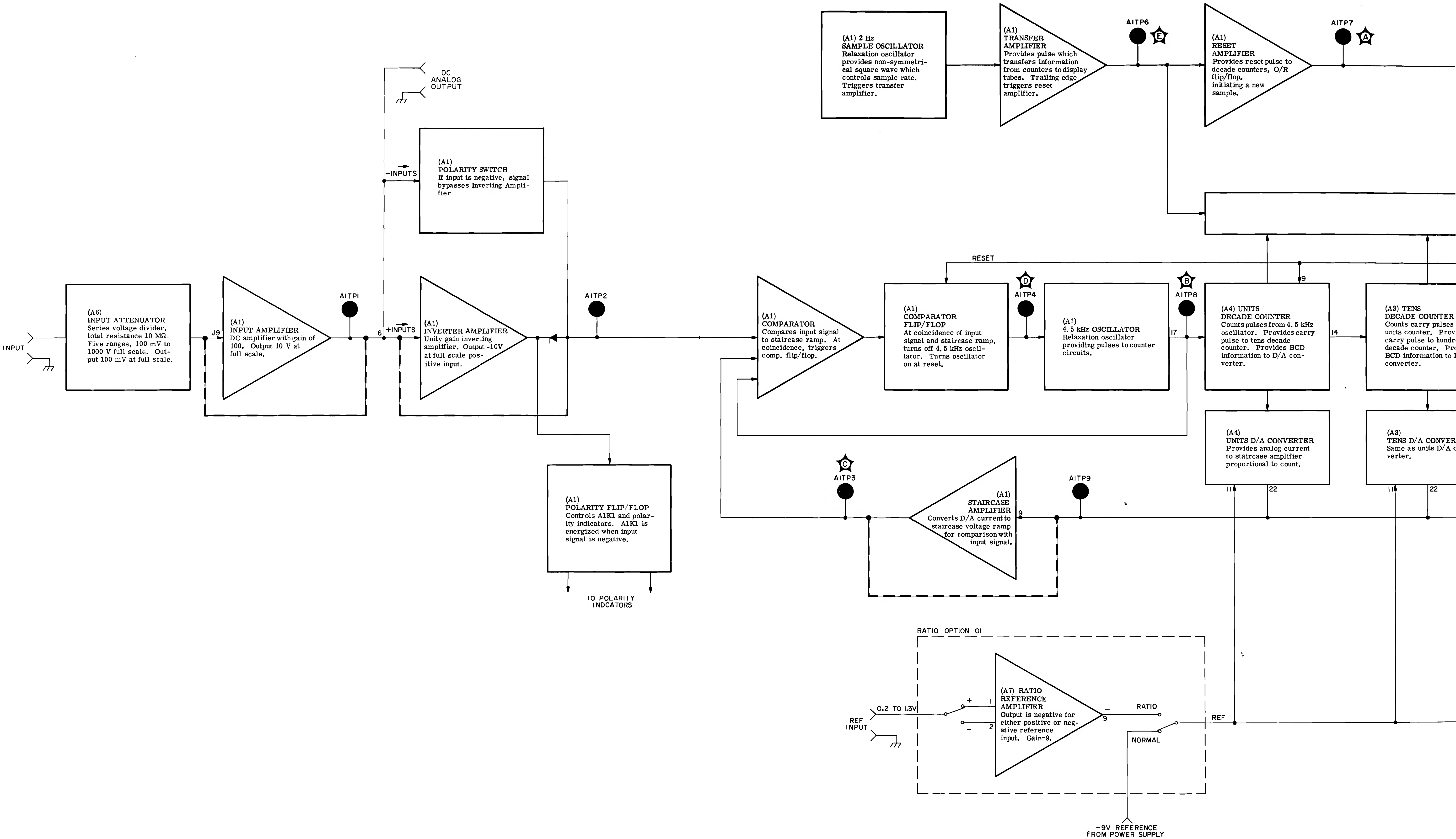


Power Supply Voltages

Test Point	Voltage (115 V Line)	Typical Variation with ±10% Line Voltage Change	Typical Ripple
A5TP1	-30.00 ± 0.02 V	± 0.05 V	10 mV p-p
A5TP3	- 9.00 ± 0.50 V	± 0.002 V	5 mV p-p
A5TP4	+30.00 ± 0.90 V	± 0.02 V	5 mV p-p
A5TP5	+17.00 ± 0.50 V	± 0.01 V	5 mV p-p
A5TP6	+ 4.00 ± 0.12 V	± 0.008 V	2 mV p-p

For a detailed block diagram analysis, see Section IV of this manual.





INPUT
(A6) INPUT ATTENUATOR Series voltage divider, total resistance 10 MΩ. Five ranges, 100 mV to 1000 V full scale. Output 100 mV at full scale.
J9
(A1) INPUT AMPLIFIER DC amplifier with gain of 100. Output 10 V at full scale.
A1TP1
6
DC ANALOG OUTPUT
-INPUTS
(A1) POLARITY SWITCH If input is negative, signal bypasses Inverting Amplifier
+INPUTS
(A1) INVERTER AMPLIFIER Unity gain inverting amplifier. Output -10V at full scale positive input.
A1TP2
(A1) POLARITY FLIP/FLOP Controls A1K1 and polarity indicators. A1K1 is energized when input signal is negative.
TO POLARITY INDCATORS
(A1) 2 Hz SAMPLE OSCILLATOR Relaxation oscillator provides non-symmetrical square wave which controls sample rate. Triggers transfer amplifier.
(A1) TRANSFER AMPLIFIER Provides pulse which transfers information from counters to display tubes. Trailing edge triggers reset amplifier.
A1TP6
E
(A1) RESET AMPLIFIER Provides reset pulse to decade counters, O/R flip/flop, initiating a new sample.
A1TP7
A
RESET
(A1) COMPARATOR Compares input signal to staircase ramp. At coincidence, triggers comp. flip/flop.
(A1) COMPARATOR FLIP/FLOP At coincidence of input signal and staircase ramp, turns off 4.5 kHz oscillator. Turns oscillator on at reset.
D
A1TP4
(A1) 4.5 kHz OSCILLATOR Relaxation oscillator providing pulses to counter circuits.
B
A1TP8
17
(A4) UNITS DECADE COUNTER Counts pulses from 4.5 kHz oscillator. Provides carry pulse to tens decade counter. Provides BCD information to D/A converter.
9
14
(A3) TENS DECADE COUNTER Counts carry pulses units counter. Prov carry pulse to hundr decade counter. Pro BCD information to converter.
(A4) UNITS D/A CONVERTER Provides analog current to staircase amplifier proportional to count.
(A3) TENS D/A CONVER Same as units D/A c verter.
11
22
C
A1TP3
(A1) STAIRCASE AMPLIFIER Converts D/A current to staircase voltage ramp for comparison with input signal.
9
A1TP9
RATIO OPTION 01
REF INPUT
0.2 TO 1.3V
+
-
1
2
(A7) RATIO REFERENCE AMPLIFIER Output is negative for either positive or negative reference input. Gain=9.
RATIO
NORMAL
REF
-9V REFERENCE FROM POWER SUPPLY

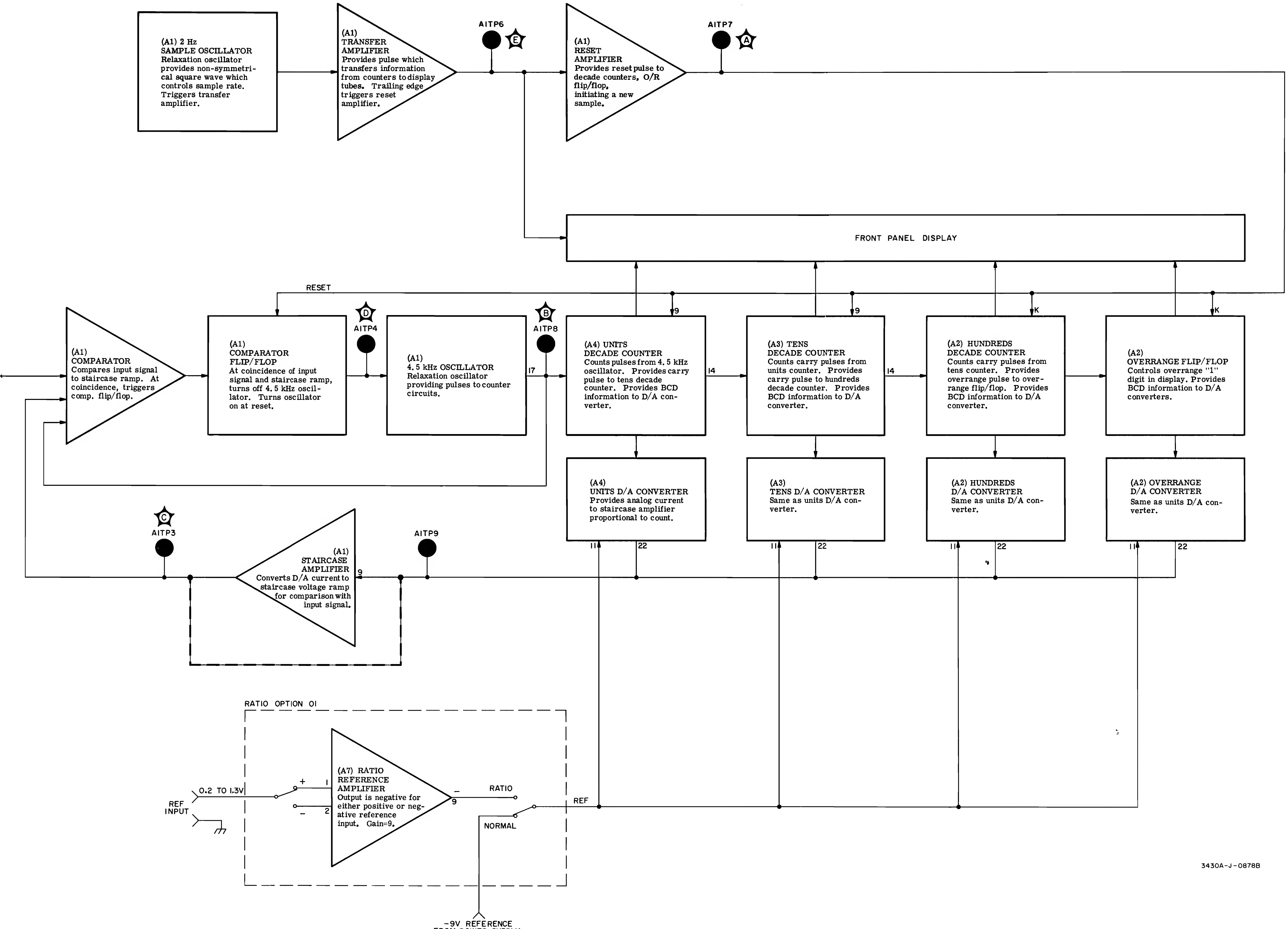
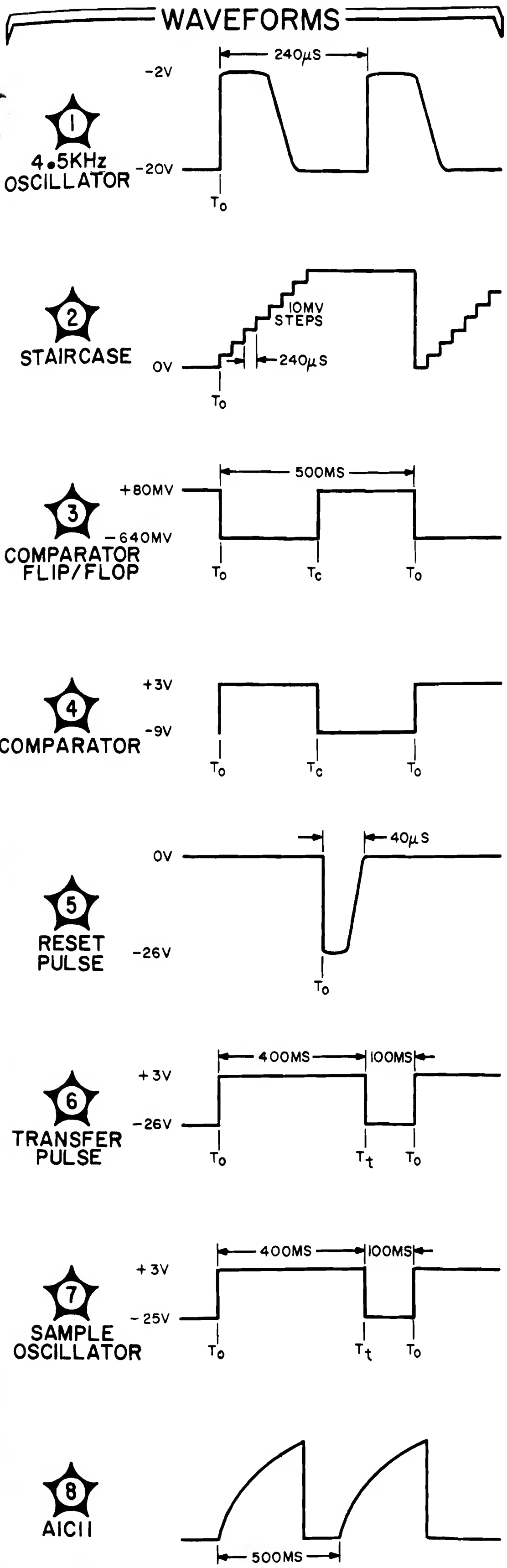


Figure 7-2. Block Diagram and Waveforms



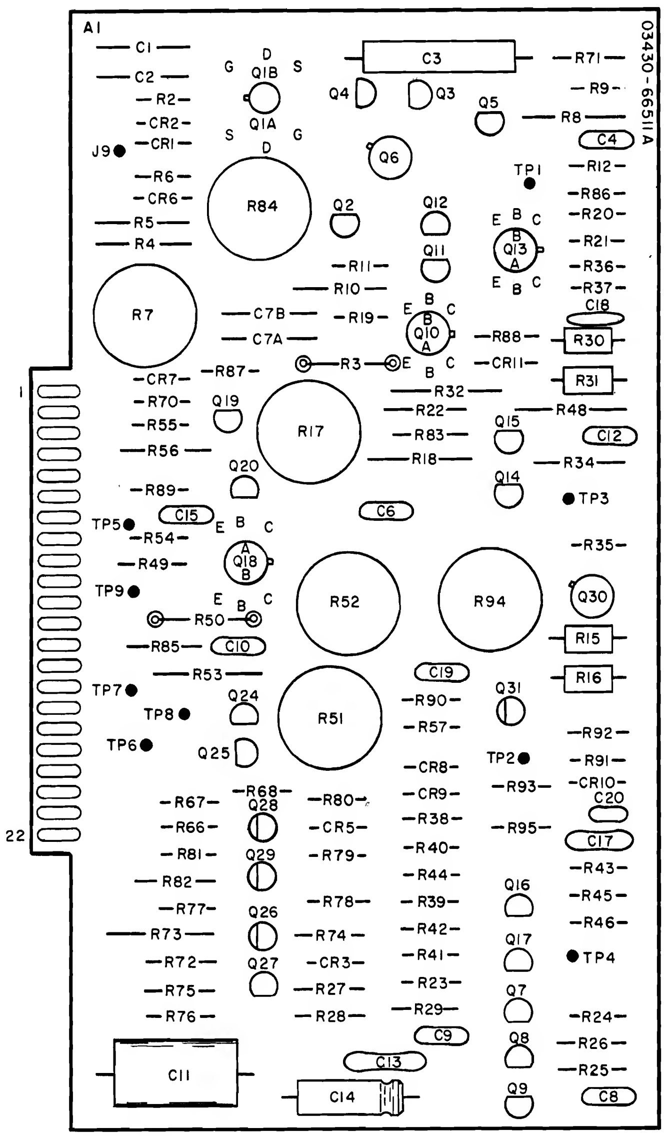
3430A-B-0793A

NOTES

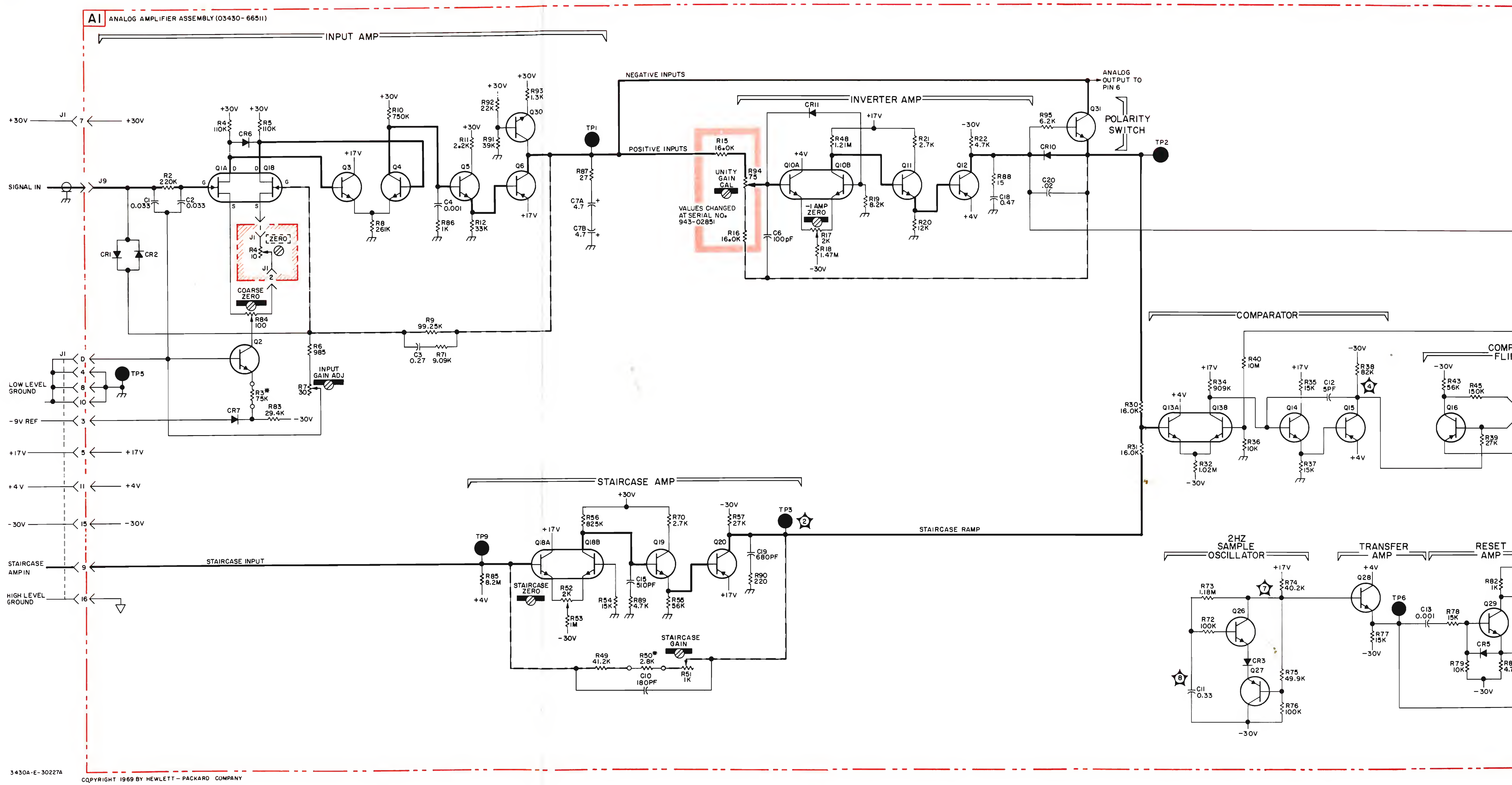
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.
2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED.

   RESISTANCE IN OHMS

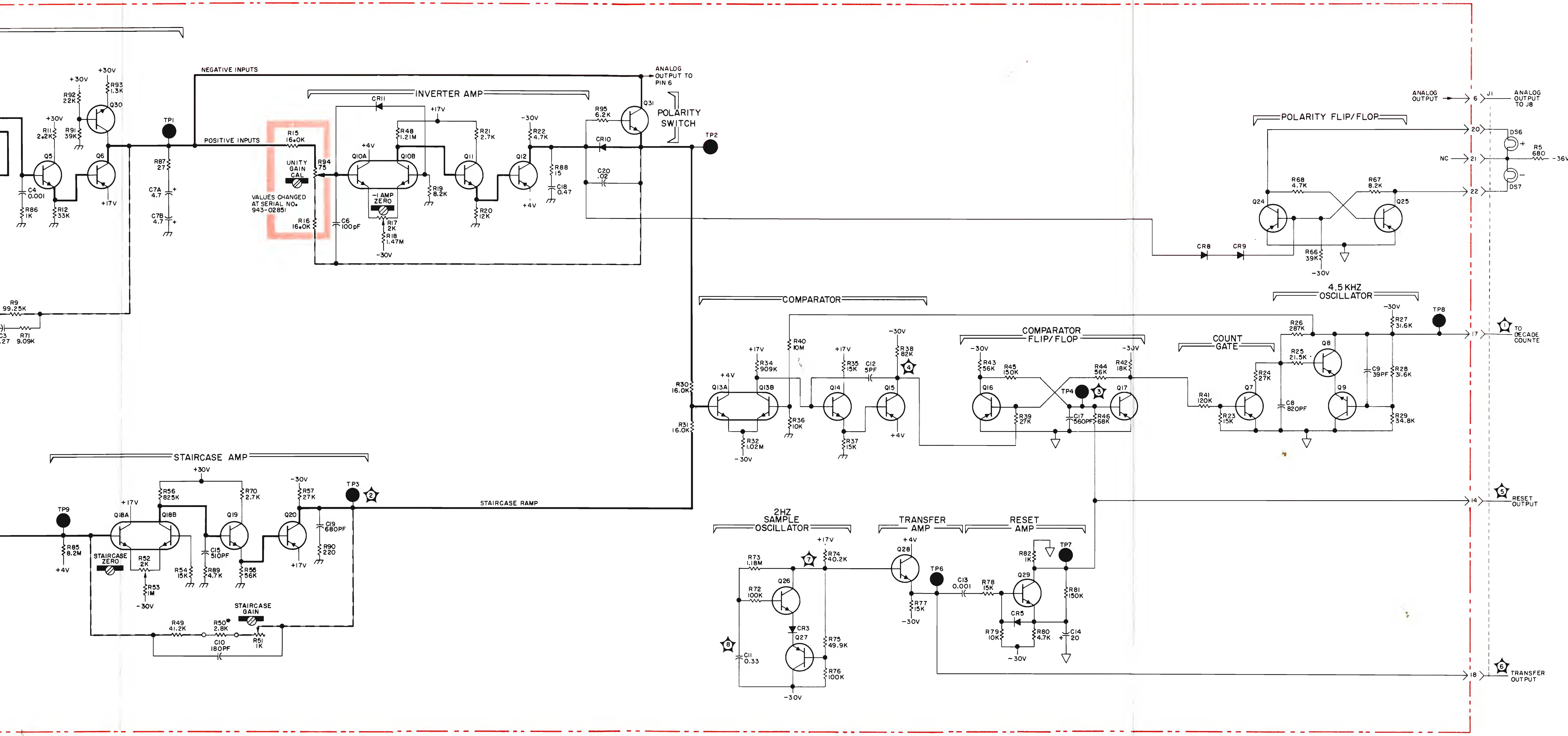
   CAPACITANCE IN MICROFARADS
3. DENOTES WAVESHAPE. SEE WAVESHAPE DRAWING.
4. DENOTES SIGNAL (LOW LEVEL) GROUND.
5. DENOTES POWER SUPPLY (HIGH LEVEL) GROUND.
6. DENOTES ASSEMBLY.
7. DENOTES MAIN SIGNAL PATH.
8. DENOTES FEEDBACK PATH.
9. DENOTES REAR PANEL MARKING.
10. DENOTES SCREWDRIVER ADJUST.
11. DENOTES COMPONENTS NOT MOUNTED ON ASSEMBLY.
12. * AVERAGE VALUE SHOWN, OPTIMUM VALUE SELECTED AT FACTORY.
13. ALL RELAYS ARE SHOWN DEENERGIZED.



3430A-B-20308



3430A-E-30227A



NOTE: SCHEMATIC DIAGRAM APPLICABLE TO INSTRUMENTS SERIAL NUMBER 933-02551 AND ABOVE.

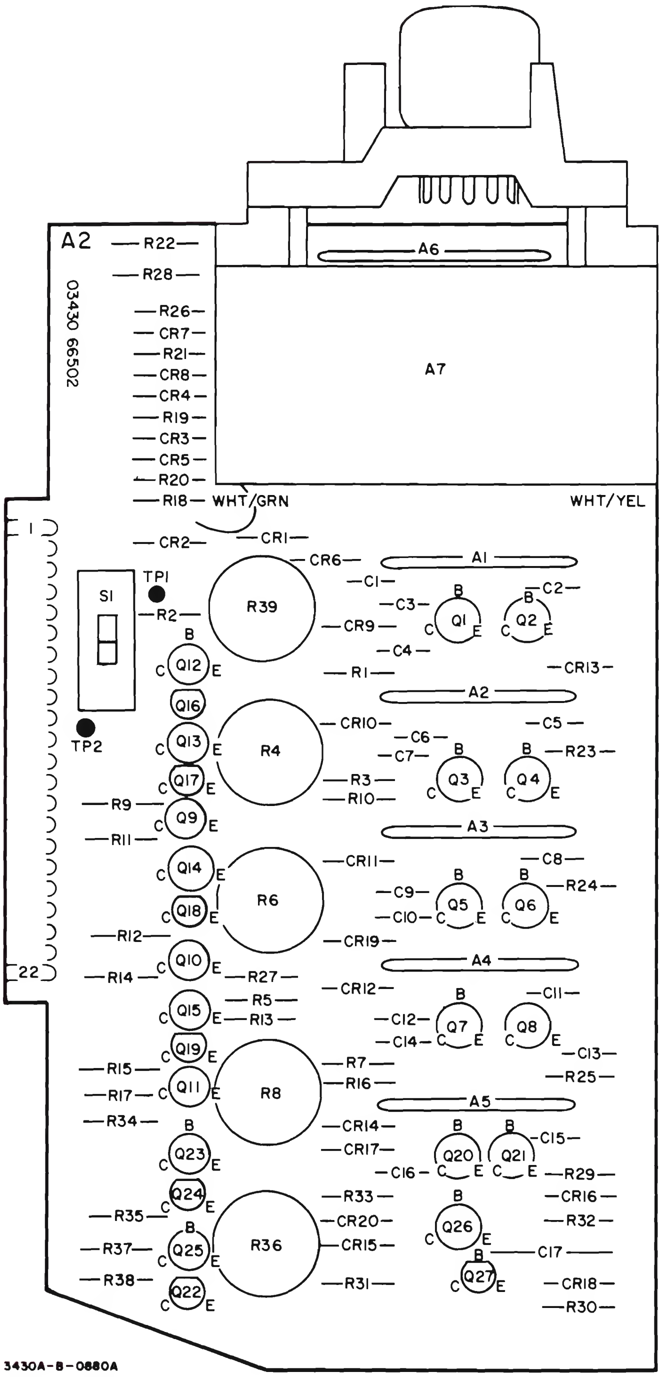
Figure 7-3. Schematic Diagram, A1 Amplifier Assembly

NOTES

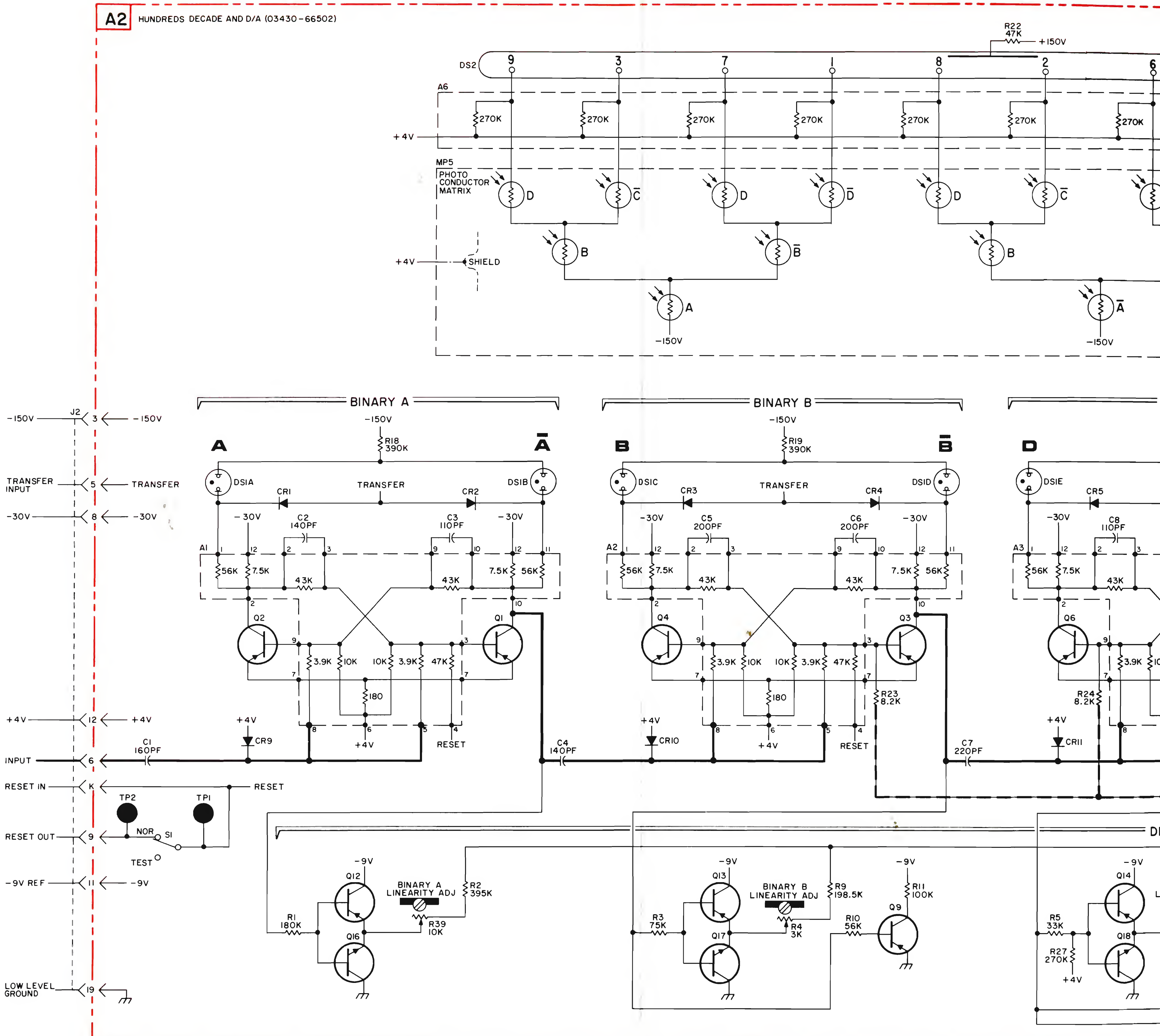
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.
2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED.

   RESISTANCE IN OHMS

   CAPACITANCE IN MICROFARADS
3. ——— — — ——— DENOTES ASSEMBLY.
4. — — — — — — — DENOTES SUBASSEMBLY.
5. DENOTES SCREWDRIVER ADJUST.



3430A-B-0880A


A2
HUNDREDS DECADE AND D/A (03430-66502)
R22
47K
+150V
DS2
9
3
7
1
8
2
6
A6
270K
+4V
MP5
PHOTO CONDUCTOR MATRIX
D
C̄
D̄
C
B
B̄
A
Ā
SHIELD
-150V
BINARY A
BINARY B
R18
390K
R19
390K
DS1A
DS1B
DS1C
DS1D
DS1E
CR1
CR2
CR3
CR4
CR5
TRANSFER
-30V
C2
140PF
C3
110PF
C5
200PF
C6
200PF
C8
110PF
A1
A2
A3
56K
7.5K
43K
Q1
Q2
Q3
Q4
Q6
3.9K
10K
47K
180
R23
8.2K
R24
8.2K
RESET
CR9
CR10
CR11
C1
160PF
C4
140PF
C7
220PF
J2
TRANSFER INPUT
INPUT
RESET IN
RESET OUT
-9V REF
LOW LEVEL GROUND
-9V
TP2
TP1
NOR
S1
TEST
Q12
Q16
Q13
Q17
Q9
Q14
Q18
BINARY A LINEARITY ADJ
BINARY B LINEARITY ADJ
R1
180K
R2
395K
R39
10K
R3
75K
R4
3K
R9
198.5K
R10
56K
R11
100K
R5
33K
R27
270K

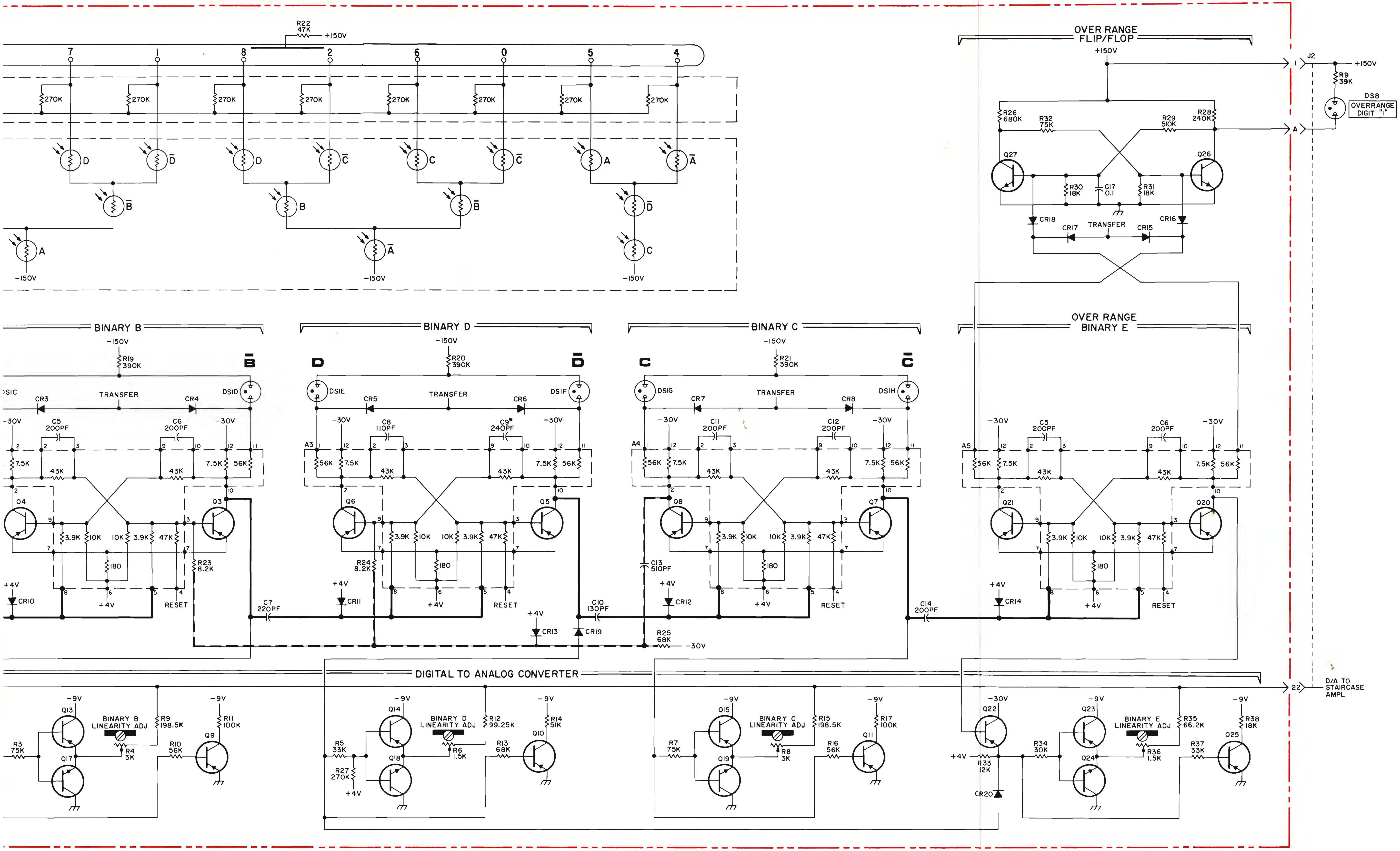


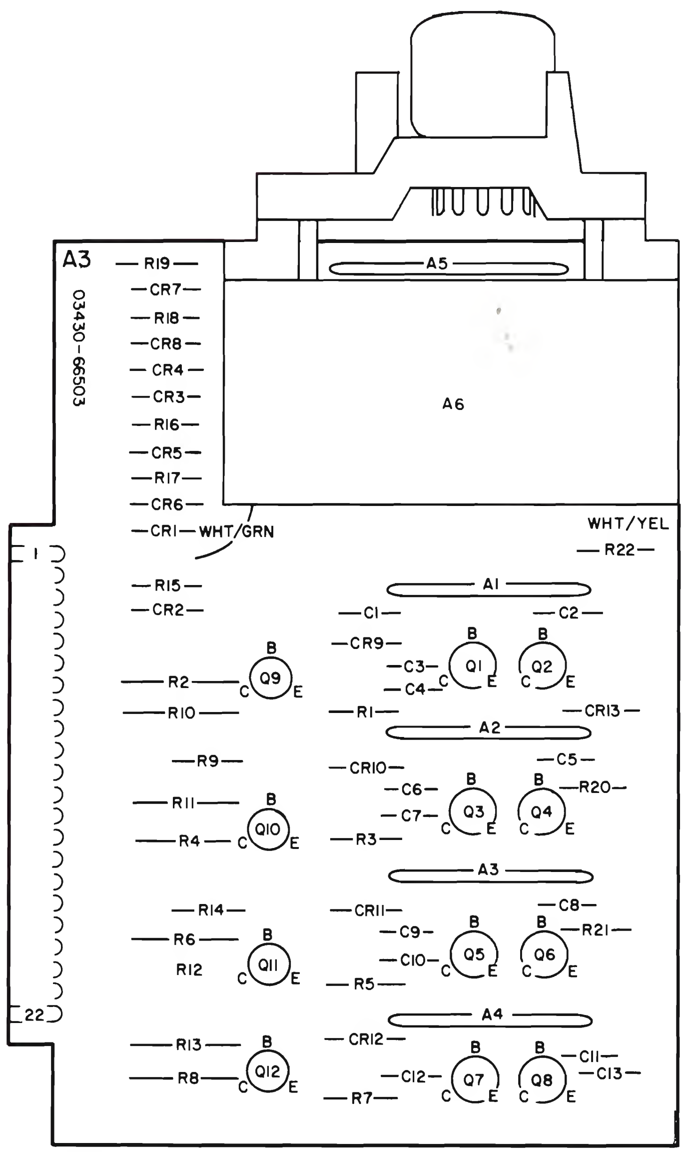
Figure 7-4. Schematic Diagram, A2 Hundreds Decade Counter and D/A

NOTES

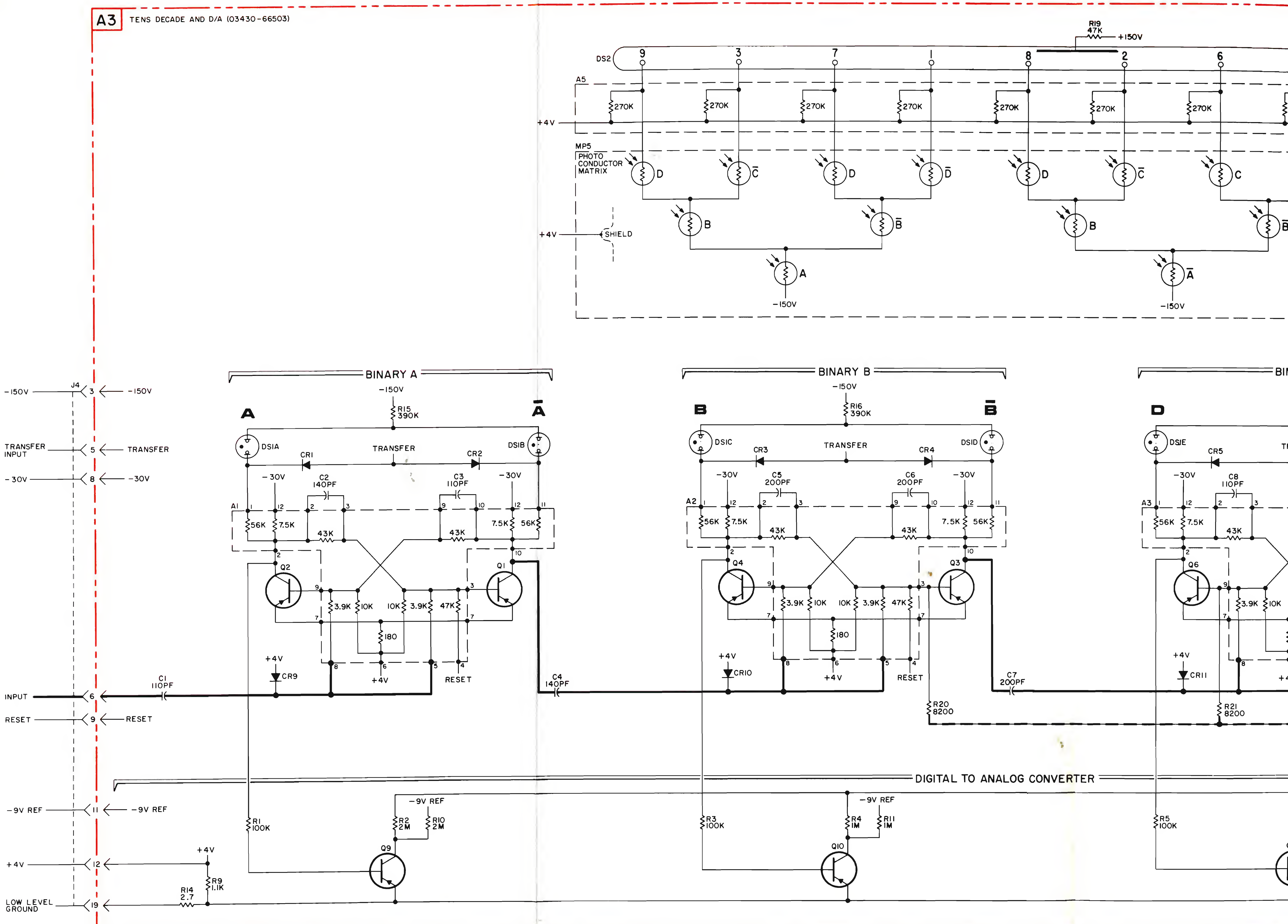
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.
2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED.

   RESISTANCE IN OHMS

   CAPACITANCE IN MICROFARADS
3. ——— – – ——— DENOTES ASSEMBLY.
4. — — — — — — — DENOTES SUBASSEMBLY.
5. DENOTES SCREWDRIVER ADJUST.



3430A-B-0881



3430A-E-07918

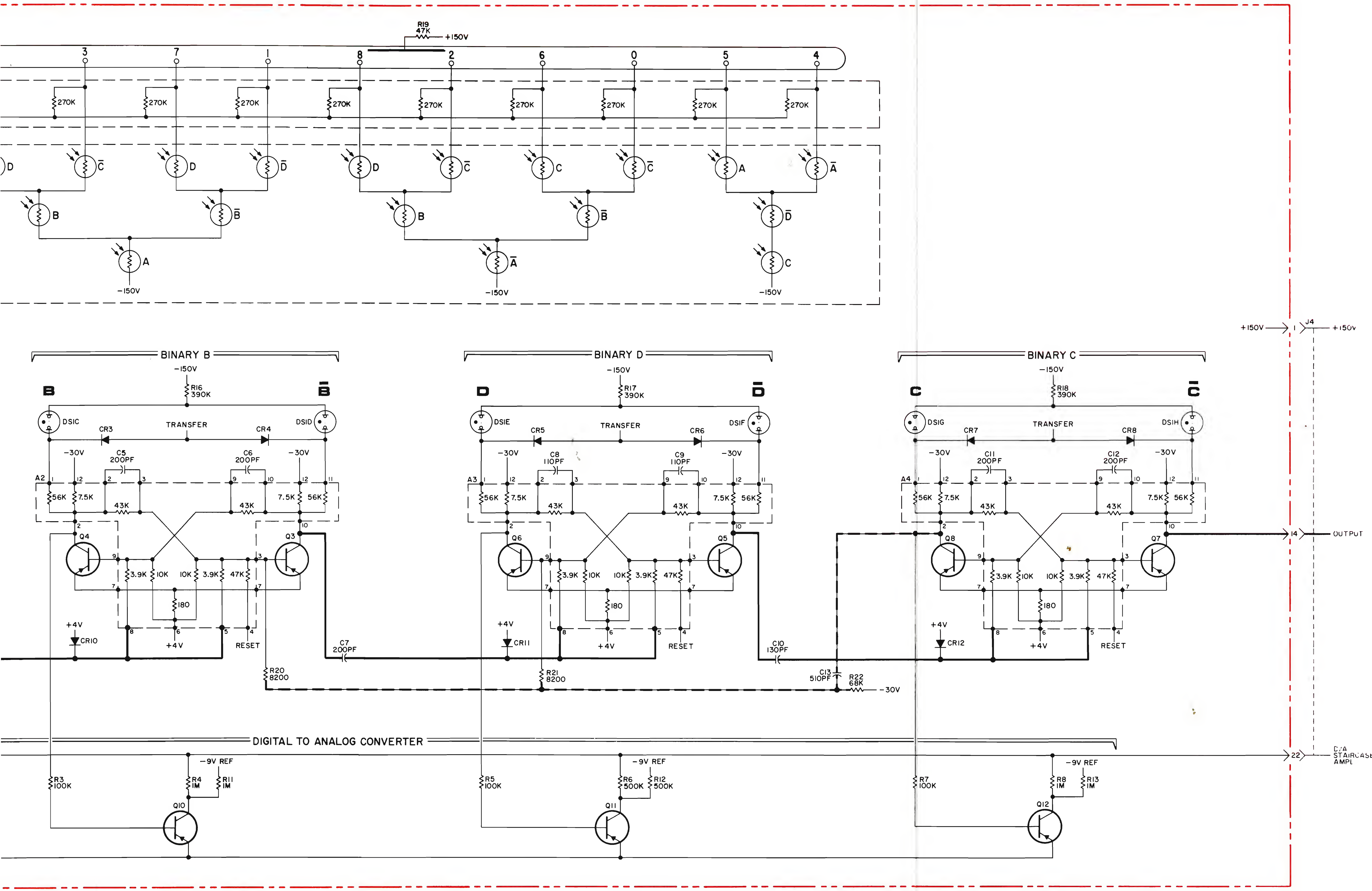


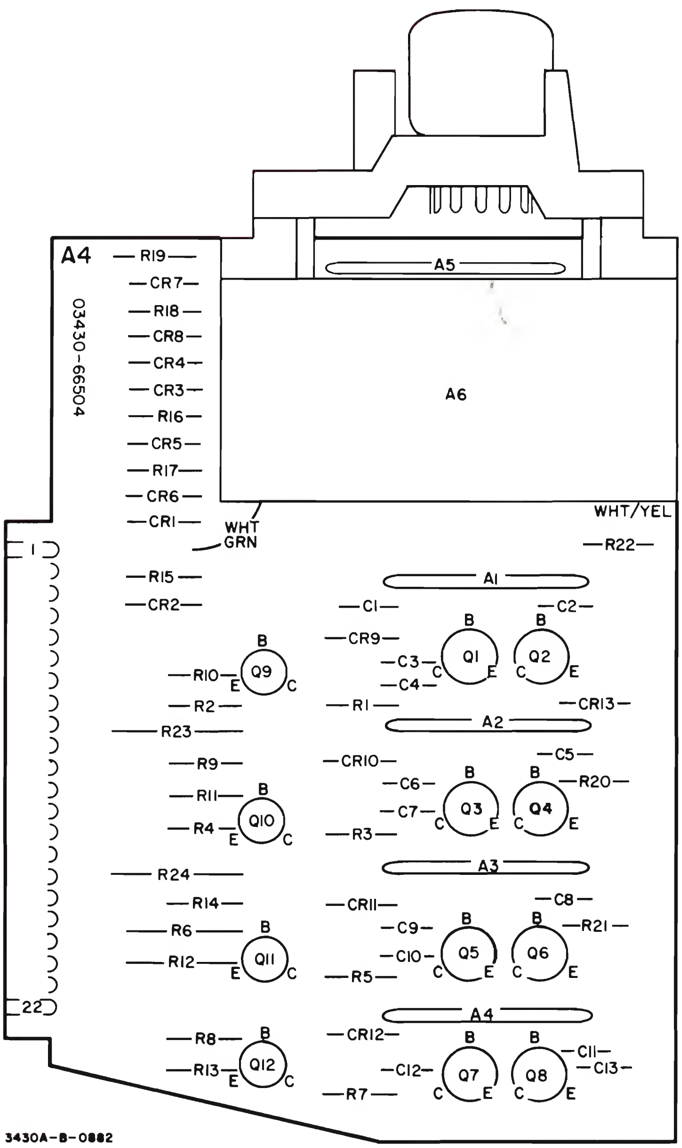
Figure 7-5. Schematic Diagram, A3 Tens Decade Counter and D/A

NOTES

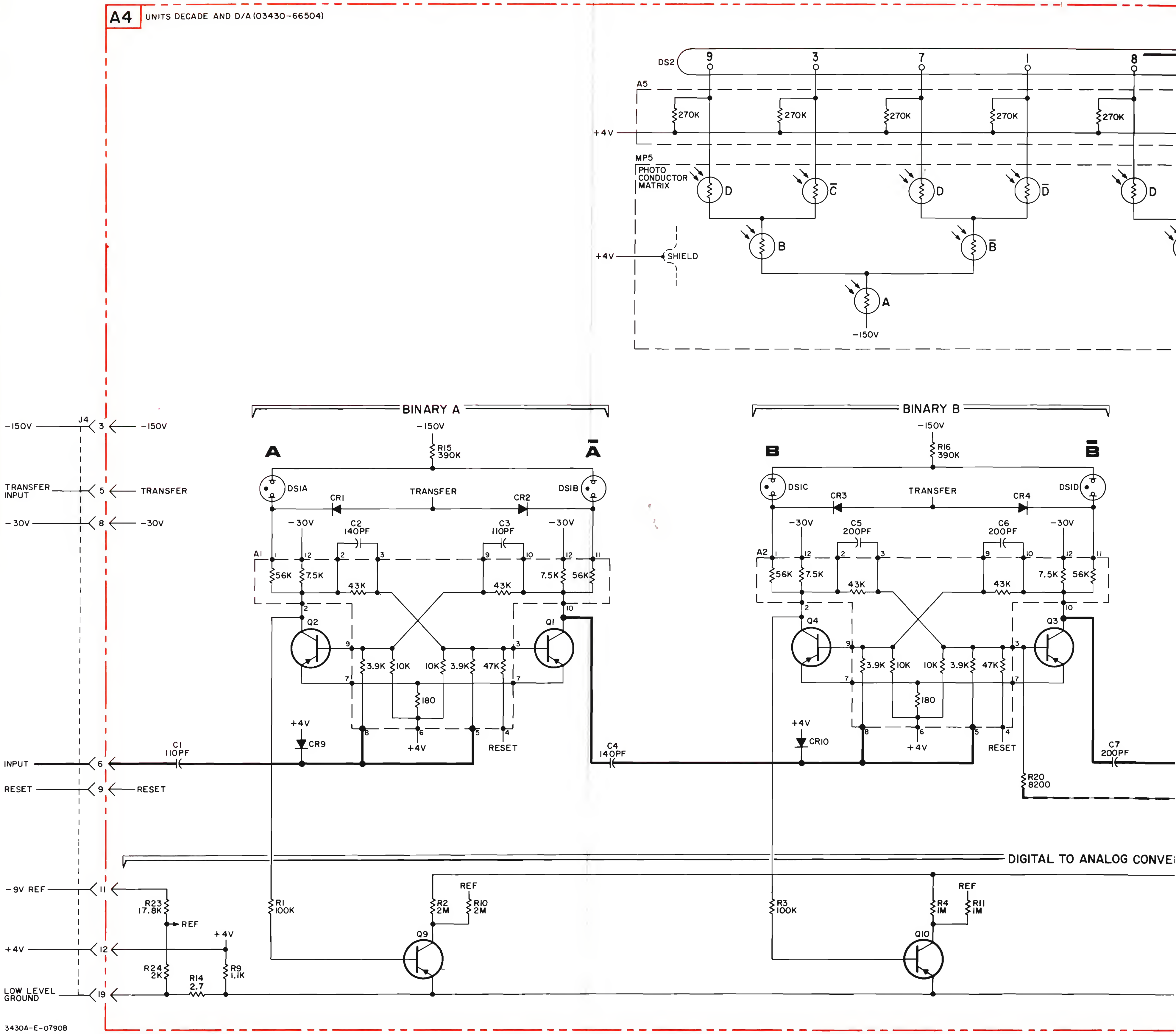
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.
2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED.

   RESISTANCE IN OHMS

   CAPACITANCE IN MICROFARADS
3. ——— — — ——— DENOTES ASSEMBLY.
4. — — — — — — — DENOTES SUBASSEMBLY.



3430A-B-0882



3430A-E-0790B

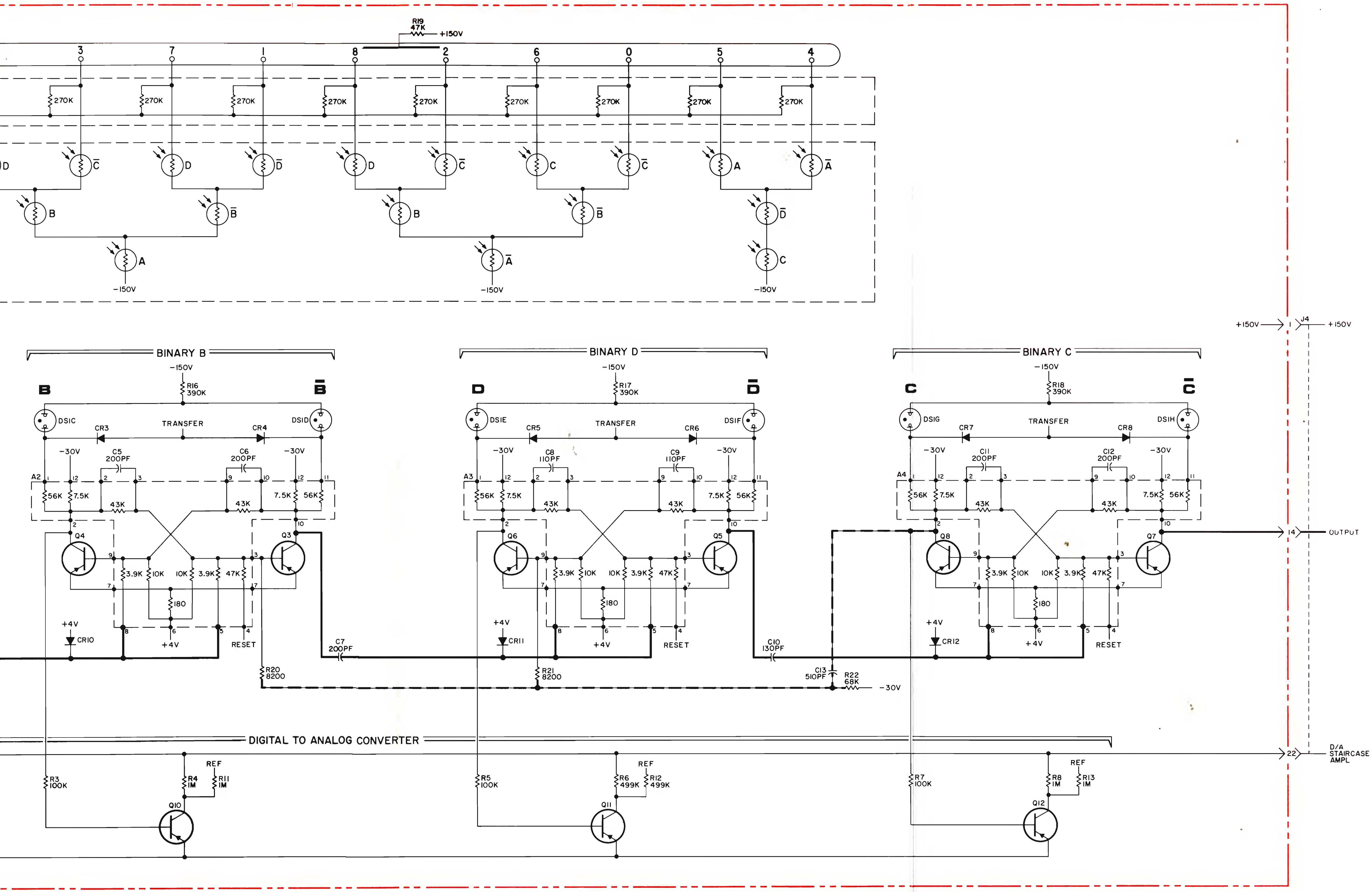
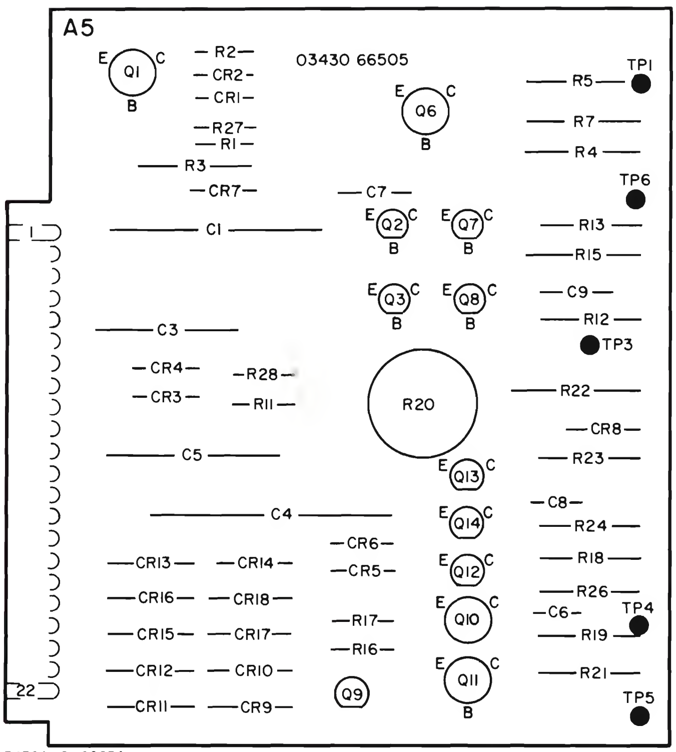


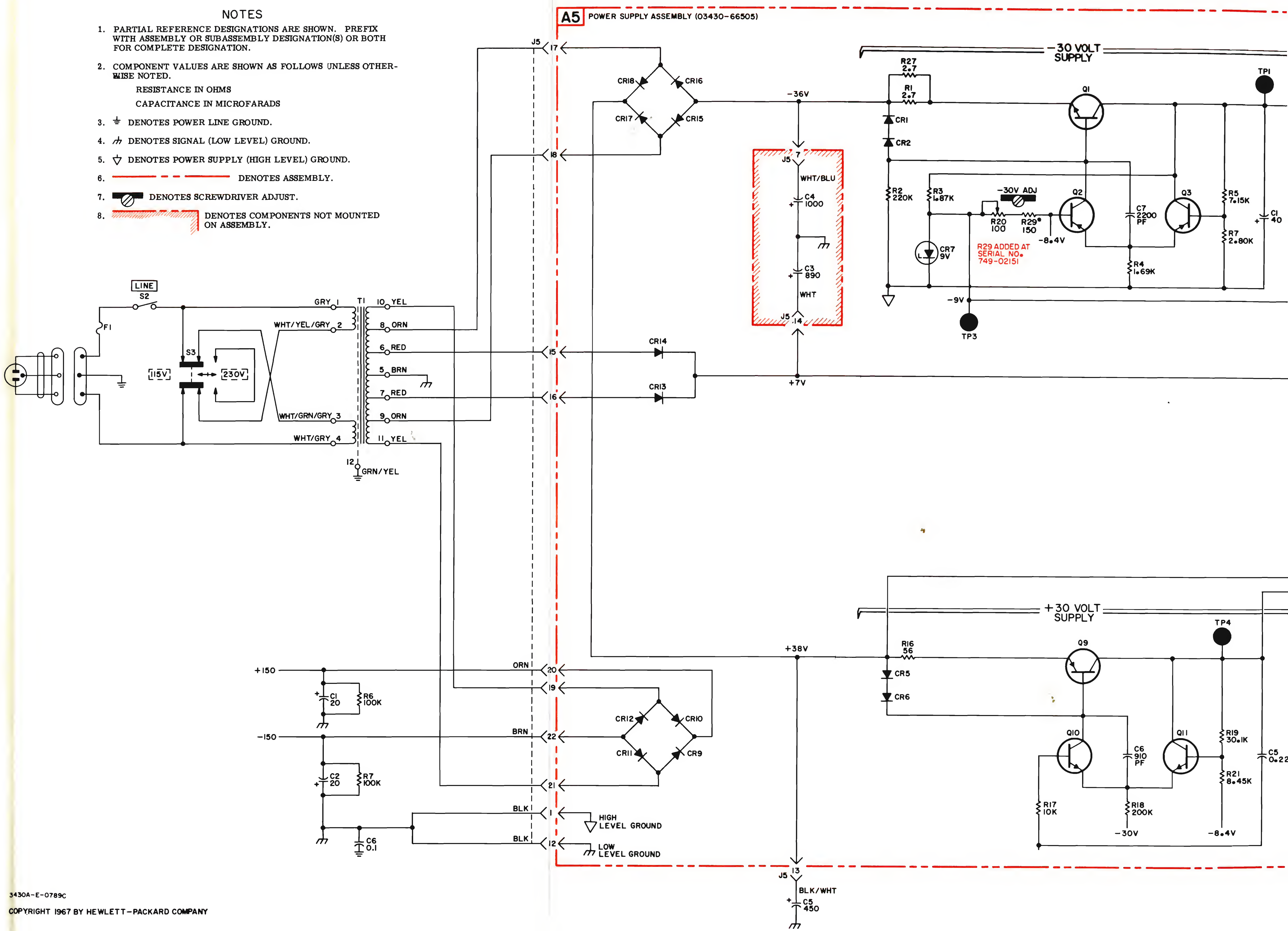
Figure 7-6. Schematic Diagram, A4 Units Decade Counter and D/A



3430A-B-0883A

NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.
2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED.
   RESISTANCE IN OHMS
   CAPACITANCE IN MICROFARADS
3. ⏚ DENOTES POWER LINE GROUND.
4. DENOTES SIGNAL (LOW LEVEL) GROUND.
5. ▽ DENOTES POWER SUPPLY (HIGH LEVEL) GROUND.
6. DENOTES ASSEMBLY.
7. DENOTES SCREWDRIVER ADJUST.
8. DENOTES COMPONENTS NOT MOUNTED ON ASSEMBLY.



3430A-E-0789C

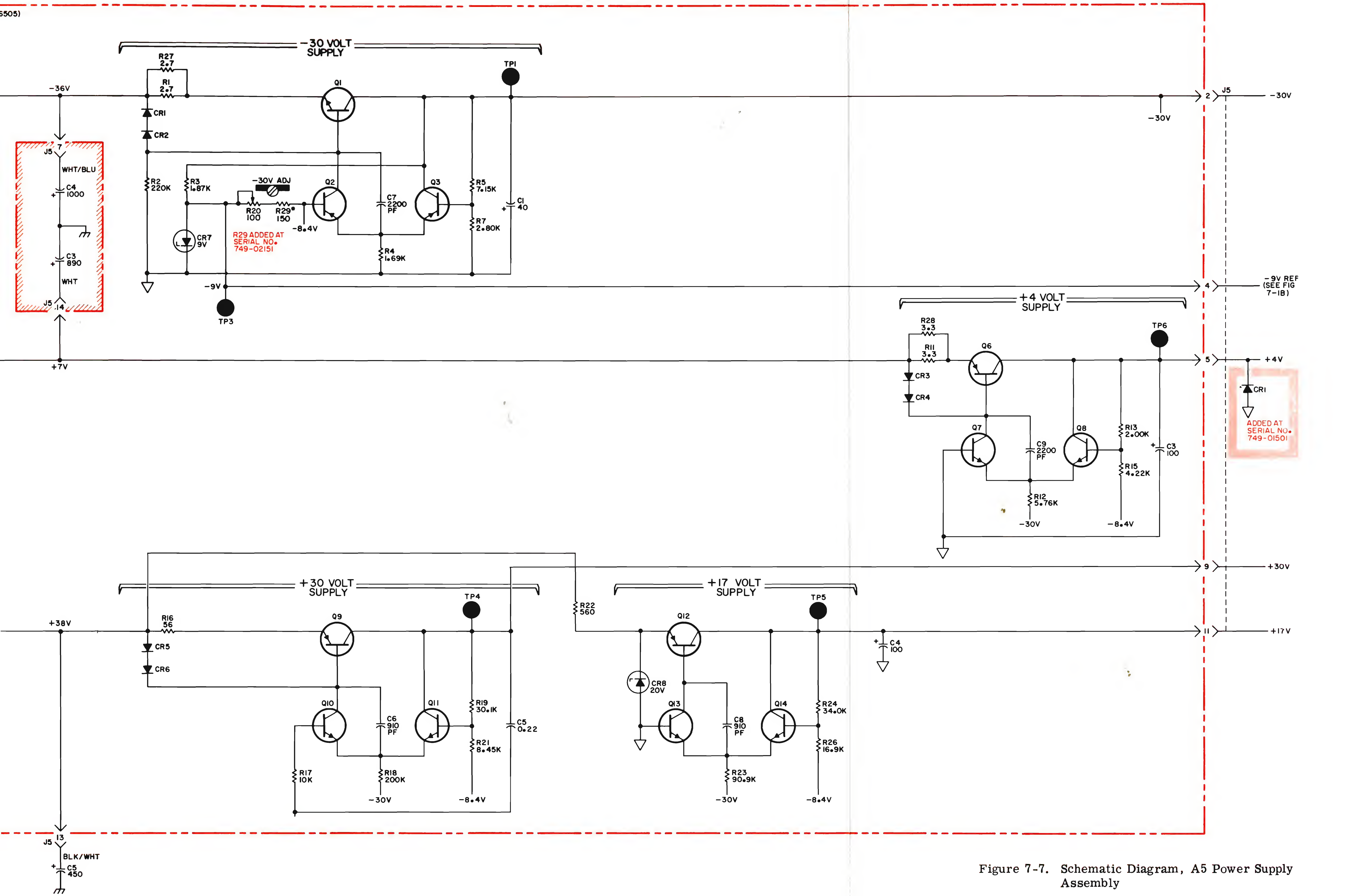
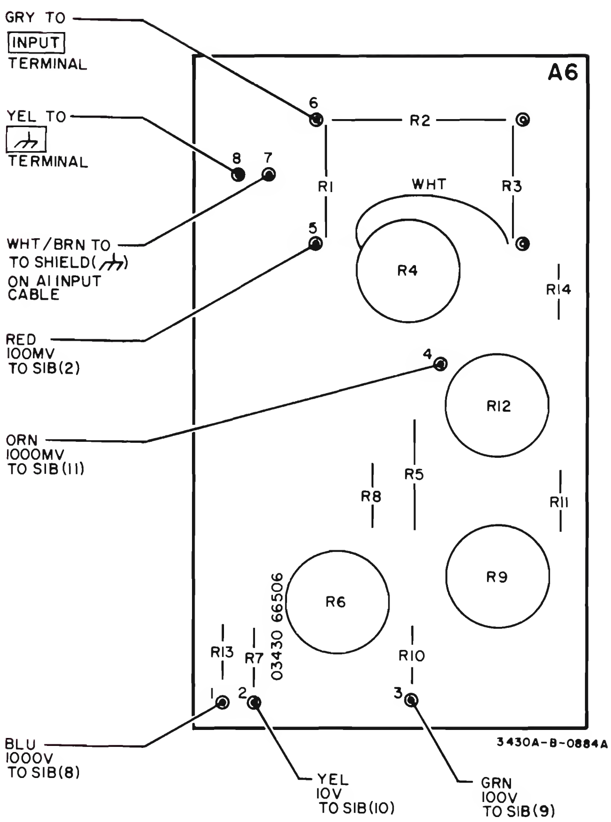
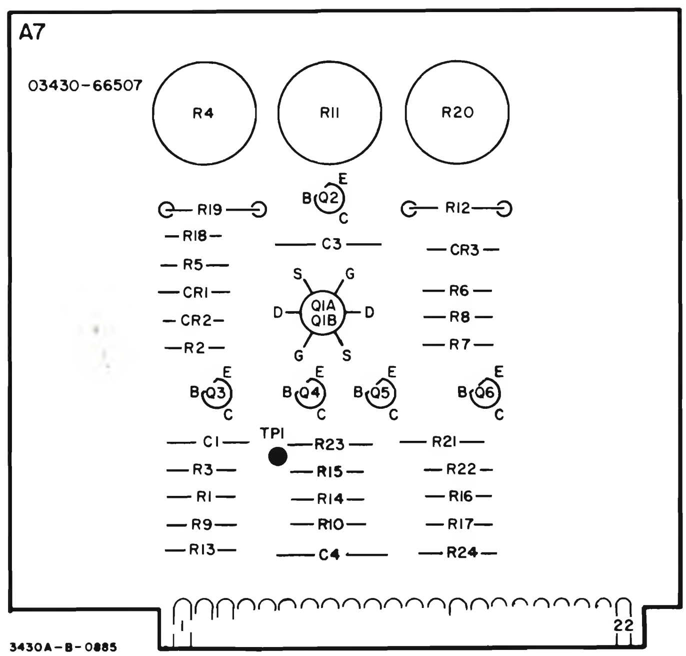
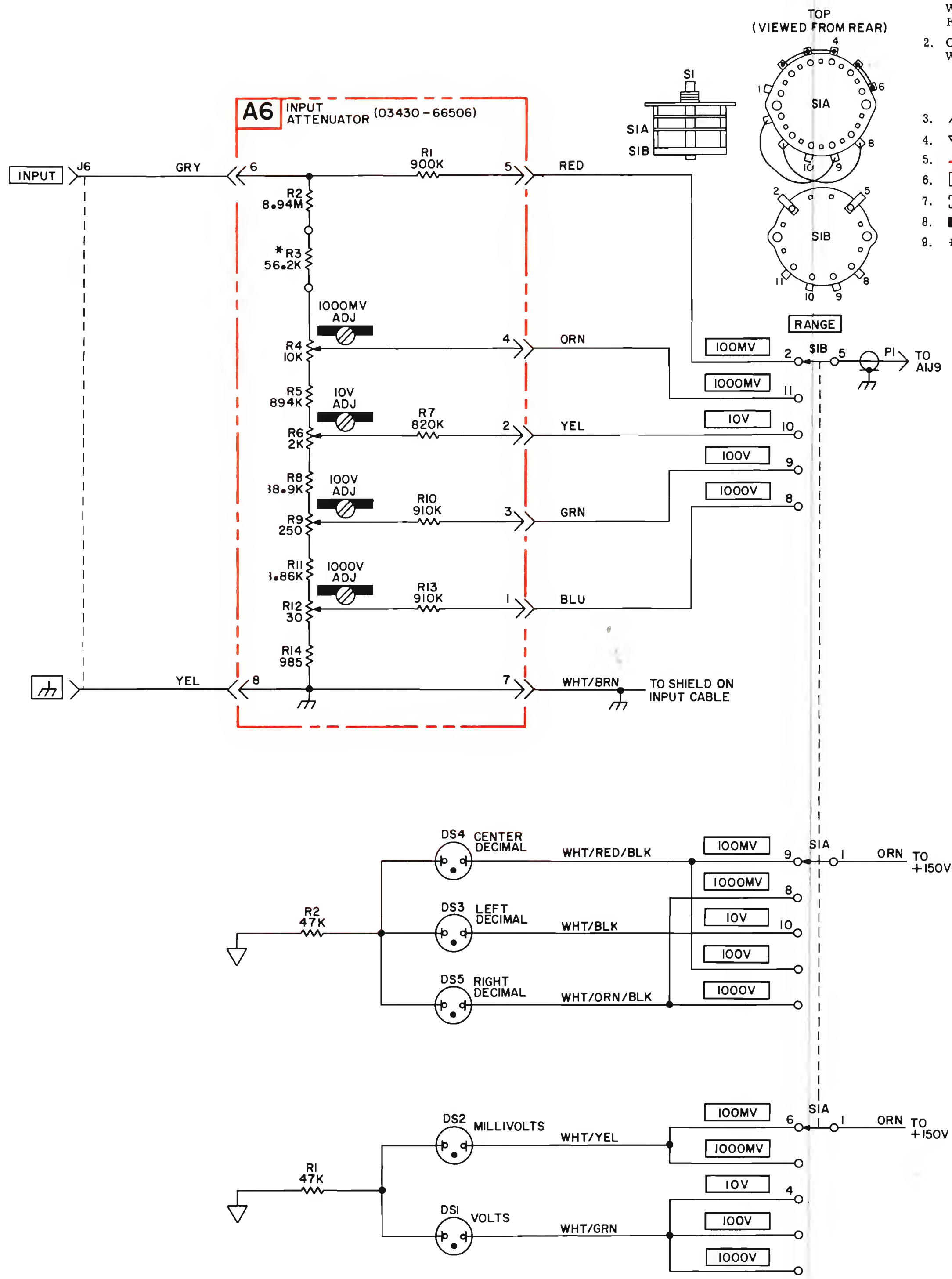


Figure 7-7. Schematic Diagram, A5 Power Supply Assembly


GRY TO
INPUT
TERMINAL
YEL TO
TERMINAL
WHT/BRN TO
TO SHIELD
ON A1 INPUT
CABLE
RED
100MV
TO SIB(2)
ORN
1000MV
TO SIB(11)
BLU
1000V
TO SIB(8)
YEL
10V
TO SIB(10)
GRN
100V
TO SIB(9)
A6
R2
R1
R3
WHT
R4
R14
R12
R5
R8
R11
R9
R6
03430 66506
R13
R7
R10
3430A-B-0884A


A7
03430-66507
R4
R11
R20
R19
R12
R18
C3
CR3
R5
Q1A
Q1B
CR1
CR2
R6
R8
R2
R7
Q2
Q3
Q4
Q5
Q6
C1
TP1
R23
R21
R3
R15
R22
R1
R14
R16
R9
R10
R17
R13
C4
R24
1
22
3430A-B-0885

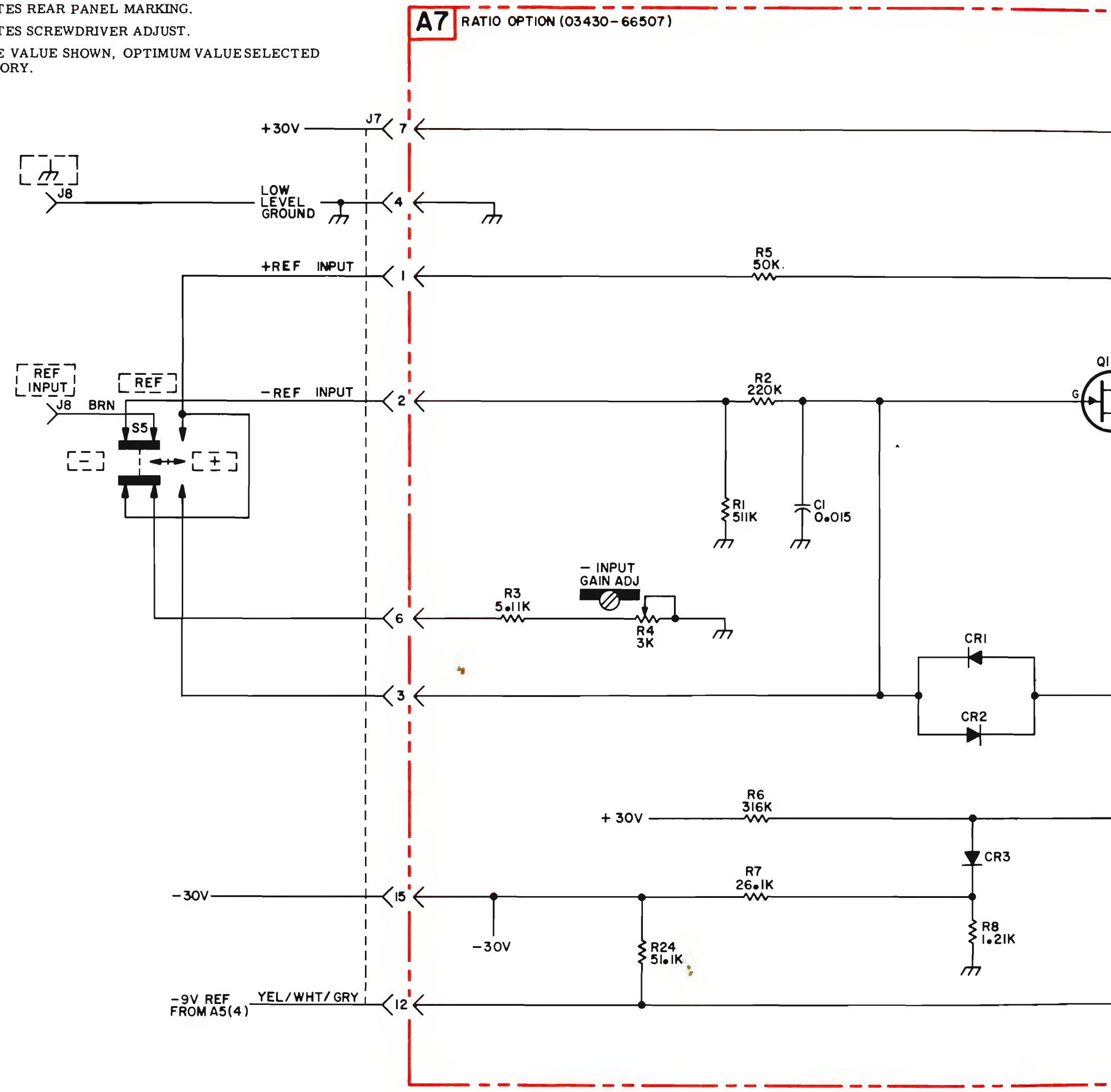


NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.
2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED.

   RESISTANCE IN OHMS

   CAPACITANCE IN MICROFARADS
3. DENOTES SIGNAL (LOW LEVEL) GROUND.
4. DENOTES POWER SUPPLY (HIGH LEVEL) GROUND.
5. DENOTES ASSEMBLY.
6. DENOTES FRONT PANEL MARKING.
7. DENOTES REAR PANEL MARKING.
8. DENOTES SCREWDRIVER ADJUST.
9. * AVERAGE VALUE SHOWN, OPTIMUM VALUE SELECTED AT FACTORY.



3430A-E-0849A

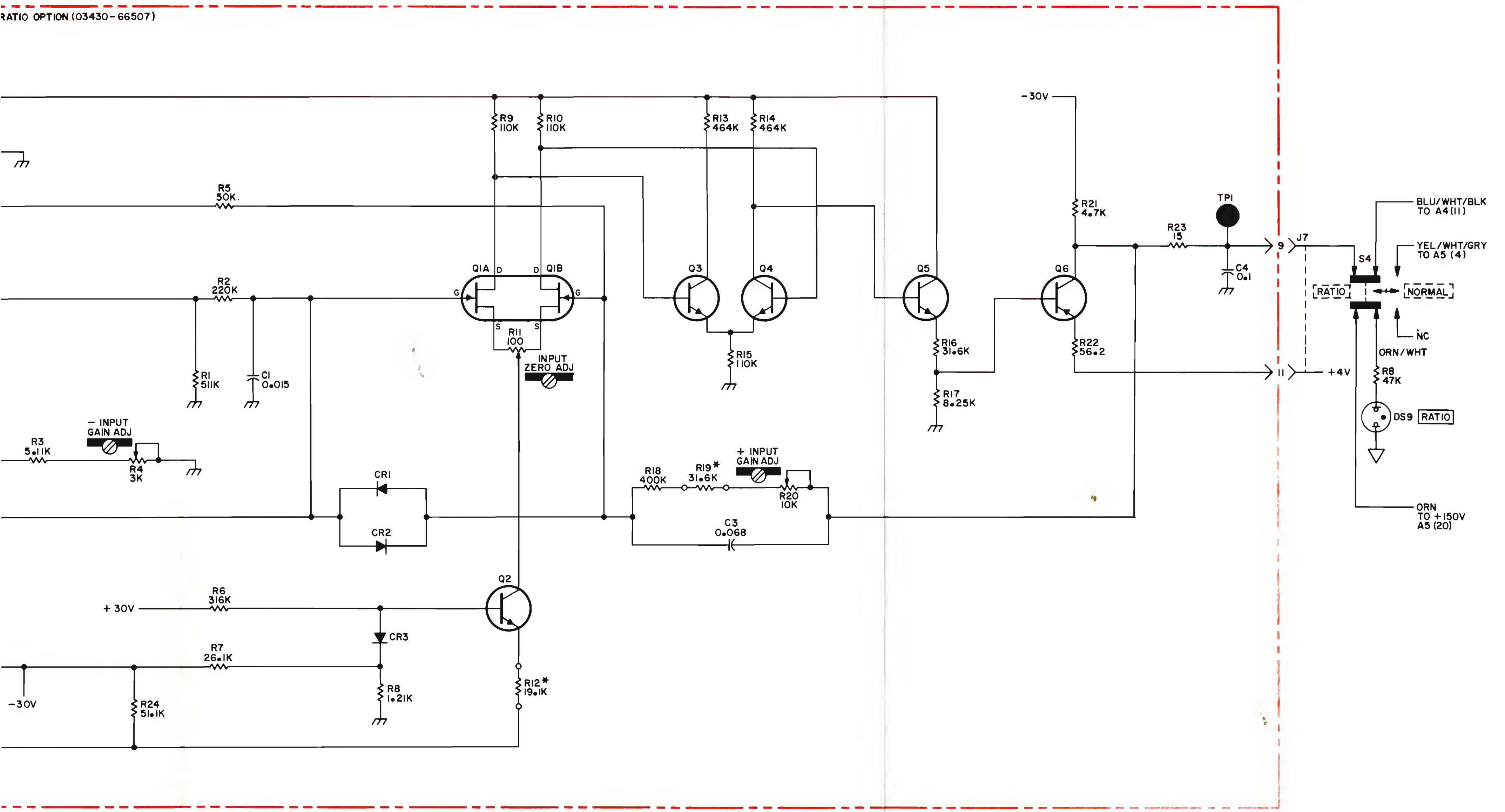


Figure 7-8. Schematic Diagram, A6 Attenuator and A7 Reference Amplifier (Option 01)

CODE LIST OF MANUFACTURERS

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbooks.

Code No.	Manufacturer	Address
00000	U.S.A. Common	Any supplier of U.S.
00136	McCoy Electronics	Mount Holly Springs, Pa.
00213	Sage Electronics Corp.	Rochester, N.Y.
00287	Cemco Inc.	Danielson, Conn.
00334	Humidial	Colton, Calif.
00348	Microtron Co., Inc.	Valley Stream, N.Y.
00373	Garlock Inc.	Cherry Hill, N.J.
00656	Aerovox Corp.	New Bedford, Mass.
00779	Amp. Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N.J.
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.
00853	Sangamo Electric Co., Pickens Div.	Pickens, S.C.
00866	Goe Engineering Co.	City of Industry, Cal.
00891	Carl E. Holmes Corp.	Los Angeles, Calif.
00929	Microlab Inc.	Livingston, N.J.
01002	General Electric Co., Capacitor Dept.	Hudson Falls, N.Y.
01009	Alden Products Co.	Brockton, Mass.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Calif.
01281	TRW Semiconductors, Inc.	Lawndale, Calif.
01295	Texas Instruments, Inc., Transistor Products Div.	Dallas, Texas
01349	The Alliance Mfg. Co.	Alliance, Ohio
01589	Pacific Relays, Inc.	Van Nuys, Calif.
01670	Gudebrod Bros. Silk Co.	New York, N.Y.
01930	Amerock Corp.	Rockford, Ill.
01961	Pulse Engineering Co.	Santa Clara, Calif.
02114	Ferroxcube Corp. of America	Saugerties, N.Y.
02116	Wheelock Signals, Inc.	Long Branch, N.J.
02286	Cole Rubber and Plastics Inc.	Sunnyvale, Calif.
02660	Amphenol-Borg Electronics Corp.	Broadview, Ill.
02735	Radio Corp. of America, Semiconductor and Materials Div.	Somerville, N.J.
02771	Vocaline Co. of America, Inc.	Old Saybrook, Conn.
02777	Hopkins Engineering Co.	San Fernando, Calif.
02875	Hudson Tool & Die Co.	Newark, N.J.
03508	G.E. Semiconductor Prod. Dept.	Syracuse, N.Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio
03797	Eldema Corp.	Compton, Calif.
03818	Parker Seal Co.	Los Angeles, Calif.
03877	Transitron Electric Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls, N.J.
03954	Singer Co., Diehl Div. Finderne Plant	Sumerville, N.J.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.
04013	Taurus Corp.	Lambertville, N.J.
04062	Arco Electronic Inc.	Great Neck, N.Y.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S.C.
04354	Precision Paper Tube Co.	Wheeling, Ill.
04404	Dymec Division of Hewlett-Packard Co.	Palo Alto, Calif.
04651	Sylvania Electric Products, Microwave Device Div.	Mountain View, Calif.
04673	Dakota Engr. Inc.	Culver City, Calif.
04713	Motorola, Inc., Semiconductor Prod. Div.	Phoenix, Arizona
04732	Filtron Co., Inc. Western Div.	Culver City, Calif.
04773	Automatic Electric Co.	Northlake, Ill.
04796	Sequoia Wire Co.	Redwood City, Calif.
04811	Precision Coil Spring Co.	El Monte, Calif.
04870	P.M. Motor Company	Westchester, Ill.
04919	Component Mfg. Service Co.	W. Bridgewater, Mass.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Calif.
05245	Components Corp.	Chicago, Ill.
05277	Westinghouse Electric Corp. Semi-Conductor Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	San Mateo, Calif.
05397	Union Carbide Corp., Elect. Div.	New York, N.Y.
05574	Viking Ind. Inc.	Canoga Park, Calif.
05593	Icore Electro-Plastics Inc.	Sunnyvale, Calif.
05616	Cosmo Plastic (c/o Electrical Spec. Co.)	Cleveland, Ohio
05624	Barber Colman Co.	Rockford, Ill.
05728	Tiffen Optical Co.	Roslyn Heights, Long Island, N.Y.
05729	Metro-Tel Corp.	Westbury, N.Y.
05783	Stewart Engineering Co.	Santa Cruz, Calif.
05820	Wakefield Engineering Inc.	Wakefield, Mass.
06004	Bassick Co., Div. of Stewart Warner Corp.	Bridgeport, Conn.
06090	Raychem Corp.	Redwood City, Calif.
06175	Bausch and Lomb Optical Co.	Rochester, N.Y.
06402	E.T.A. Products Co. of America	Chicago, Ill.
06540	Amatom Electronic Hardware Co., Inc.	New Rochelle, N.Y.
06555	Beede Electrical Instrument Co., Inc.	Penacook, N.H.
06666	General Devices Co., Inc.	Indianapolis, Ind.
06751	Components Inc., Ariz. Div.	Phoenix, Ariz.
06812	Torrington Mfg. Co., West Div.	Van Nuys, Calif.
06980	Varian Assoc. Eimac Div.	San Carlos, Calif.
07088	Kelvin Electric Co.	Van Nuys, Calif.
07126	Digitran Co.	Pasadena, Calif.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp. Electronic Tube Div.	Elmira, N.Y.
07149	Filmohm Corp.	New York, N.Y.
07233	Cinch-Graphik Co.	City of Industry, Calif.
07256	Silicon Transistor Corp.	Carle Place, N.Y.
07261	Avnet Corp.	Culver City, Calif.
07263	Fairchild Camera & Inst. Corp. Semiconductor Div.	Mountain View, Calif.
07322	Minnesota Rubber Co.	Minneapolis, Minn.
07387	Birtcher Corp., The	Monterey Park, Calif.
07397	Sylvania Elect. Prod. Inc., Mt. View Operations	Mountain View, Calif.
07700	Technical Wire Products Inc.	Cranford, N.J.
07829	Bodine Elect. Co.	Chicago, Ill.
07910	Continental Device Corp.	Hawthorne, Calif.
07933	Raytheon Mfg. Co., Semiconductor Div.	Mountain View, Calif.
07980	Hewlett-Packard Co., Boonton Radio Div.	Rockaway, N.J.
08145	U.S. Engineering Co.	Los Angeles, Calif.
08289	Blinn, Delbert Co.	Pomona, Calif.
08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada
08524	Deutsch Fastener Corp.	Los Angeles, Calif.
08664	Bristol Co., The	Waterbury, Conn.
08717	Sloan Company	Sun Valley, Calif.
08718	ITT Cannon Electric Inc., Phoenix Div.	Phoenix, Arizona
08727	National Radio Lab. Inc.	Paramus, N.J.
08792	CBS Electronics Semiconductor Operations, Div of C.B.S. Inc.	Lowell, Mass.
08806	General Electric Co. Miniat. Lamp Dept.	Cleveland, Ohio
08984	Mel-Rain	Indianapolis, Ind.
09026	Babcock Relays Div.	Costa Mesa, Calif.
09134	Texas Capacitor Co.	Houston, Texas
09145	Tech. Ind. Inc. Atohm Elect.	Burbank, Calif.
09250	Electro Assemblies, Inc.	Chicago, Ill.
09353	C & K Components Inc.	Newton, Mass.
09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada
09922	Burndy Corp.	Norwalk, Conn.
10214	General Transistor Western Corp.	Los Angeles, Calif.
10411	Ti-Tal, Inc.	Berkeley, Calif.
10646	Carborundum Co.	Niagara Falls, N.Y.
11236	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Telephone of California, Inc.	So. Pasadena, Calif.
11242	Bay State Electronics Corp.	Waltham, Mass.
11312	Teledyne Inc., Microwave Div.	Palo Alto, Calif.
11314	National Seal	Downey, Calif.
11453	Precision Connector Corp.	Jamaica, N.Y.
11534	Duncan Electronics Inc.	Costa Mesa, Calif.
11711	General Instrument Corp., Semiconductor Div., Products Group	Newark, N.J.
11717	Imperial Electronic, Inc.	Buena Park, Calif.
11870	Melabs, Inc.	Palo Alto, Calif.
12040	National Semiconductor	Danbury, Conn.
12136	Philadelphia Handle Co.	Camden, N.J.
12361	Grove Mfg. Co., Inc.	Shady Grove, Pa.
12574	Gulton Ind. Inc. Data System Div.	Albuquerque, N.M.
12697	Clarostat Mfg. Co.	Dover, N.H.
12728	Elmar Filter Corp.	W. Haven, Conn.
12859	Nippon Electric Co., Ltd.	Tokyo, Japan
12881	Metex Electronics Corp.	Clark, N.J.
12930	Delta Semiconductor Inc.	Newport Beach, Calif.
12954	Dickson Electronics Corp.	Scottsdale, Arizona
13103	Thermolloy	Dallas, Texas
13396	Telefunken (GmbH)	Hanover, Germany
13835	Midland-Wright Div. of Pacific Industries, Inc.	Kansas City, Kansas
14099	Sem-Tech	Newbury Park, Calif.
14193	Calif. Resistor Corp.	Santa Monica, Calif.
14298	American Components, Inc.	Conshohocken, Pa.
14433	ITT Semiconductor, A Div. of Int. Telephone & Telegraph Corp.	West Palm Beach, Fla.
14493	Hewlett-Packard Company	Loveland, Colo.
14655	Cornell Dublier Electric Corp.	Newark, N.J.
14674	Corning Glass Works	Corning, N.Y.
14752	Electro Cube Inc.	San Gabriel, Calif.
14960	Williams Mfg. Co.	San Jose, Calif.
15203	Webster Electronics Co.	New York, N.Y.
15287	Scionics Corp.	Northridge, Calif.
15291	Adjustable Bushing Co.	N. Hollywood, Calif.
15556	Micron Electronics	Garden City, Long Island, N.Y.
15566	Amprobe Inst. Corp.	Lynbrook, N.Y.
15631	Cabletronics	Costa Mesa, Calif.
15772	Twentieth Century Coil Spring Co.	Santa Clara, Calif.
15801	Fenwal Elect. Inc.	Framingham, Mass.
15818	Amelco Inc.	Mt. View, Calif.
16037	Spruce Pine Mica Co.	Spruce Pine, N.C.
16179	Omni-Spectra Inc.	Farmington, Mich.
16352	Computer Diode Corp.	Lodi, N.J.
16585	Boots Aircraft Nut Corp.	Pasadena, Calif.
16688	Ideal Prec. Meter Co., Inc. De Jur Meter Div.	Brooklyn, N.Y.
16758	Delco Radio Div. of G.M. Corp.	Kokoma, Ind.
17109	Thermonetics Inc.	Canoga Park, Calif.
17474	Tranex Company	Mountain View, Calif.
17554	Components Inc.	Biddeford, Ma.
17675	Hamlin Metal Products Corp.	Akron, Ohio
17745	Angstrohm Prec. Inc.	No. Hollywood, Calif.
17870	McGraw-Edison Co.	Manchester, N.H.
18042	Power Design Pacific Inc.	Palo Alto, Calif.
18083	Clevite Corp., Semiconductor Div.	Palo Alto, Calif.
18324	Signetics Corp.	Sunnyvale, Calif.
18476	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
18486	TRW Elect. Comp. Div.	Des Plaines, Ill.
18583	Curtis Instrument, Inc.	Mt. Kisco, N.Y.
18612	Vishay Instruments Inc.	Malvern, Pa.
18873	E.I. DuPont and Co., Inc.	Wilmington, Del.
18911	Durant Mfg. Co.	Milwaukee, Wis.
19315	The Bendix Corp., Navigation & Control Div.	Teterboro, N.J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.	West Orange, N.J.
19589	Concoa	Baldwin Park, Calif.
19644	LRC Electronics	Horseheads, N.Y.
19701	Electra Mfg. Co.	Independence, Kansas
20183	General Atronics Corp.	Philadelphia, Pa.
21226	Executone, Inc.	Long Island City, N.Y.
21335	Fafnir Bearing Co., The	New Britain, Conn.
21520	Fansteel Metallurgical Corp.	N. Chicago, Ill.
23042	Texscan Corp.	Indianapolis, Ind.
23783	British Radio Electronics Ltd.	Washington, D.C.
24455	G.E. Lamp Division	Nela Park, Cleveland, Ohio

00015-47
Revised: April, 1969

From: FSC. Handbook Supplements

CODE LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer	Address
24655	General Radio Co.	West Concord, Mass.
24681	Memcor Inc., Comp. Div.	Huntington, Ind.
24796	Parelco Inc.	San Juan Capistrano, Calif.
26365	Gries Reproducer Corp.	New Rochelle, N.Y.
26462	Grobet File Co. of America, Inc.	Carlstadt, N.J.
26851	Compac/Hollister Co.	Hollister, Calif.
26992	Hamilton Watch Co.	Lancaster, Pa.
27251	Specialities Mfg. Co., Inc.	Stratford, Conn.
28480	Hewlett-Packard Co.	Palo Alto, Calif.
28520	Heyman Mfg. Co.	Kenilworth, N.J.
30817	Instrument Specialties Co., Inc.	Little Falls, N.J.
33173	G.E. Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm Inc.	Chicago, Ill.
36196	Stanwyck Coil Products Ltd.	Hawkesbury, Ontario, Canada
36287	Cunningham, W.H. & Hill, Ltd.	Toronto Ontario, Canada
37942	P.R. Mallory & Co. Inc.	Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.	Akron, Ohio
40920	Miniature Precision Bearings, Inc.	Keene, N.H.
42190	Muter Co.	Chicago, Ill.
43990	C.A. Norgren Co.	Englewood, Colo.
44655	Ohmite Mfg. Co.	Skokie, Ill.
46384	Penn Eng. & Mfg. Corp.	Doylestown, Pa.
47904	Polaroid Corp.	Cambridge, Mass.
48620	Precision Thermometer & Inst. Co.	Southampton, Pa.
49956	Microwave & Power Tube Div.	Waltham, Mass.
52090	Rowan Controller Co.	Westminster, Md.
52983	Sanborn Company	Waltham, Mass.
54294	Shallcross Mfg. Co.	Selma, N.C.
55026	Simpson Electric Co.	Chicago, Ill.
55933	Sonotone Corp.	Elmsford, N.Y.
55938	Raytheon Co. Commercial Apparatus & Systems Div.	So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
56289	Sprague Electric Co.	North Adams, Mass.
59446	Telex Corp.	Tulsa, Okla.
59730	Thomas & Betts Co.	Elizabeth, N.J.
60741	Triplett Electrical Inst. Co.	Bluffton, Ohio
61775	Union Switch and Signal, Div. of Westinghouse Air Brake Co.	Pittsburgh, Pa.
62119	Universal Electric Co.	Owosso, Mich.
63743	Ward-Leonard Electric Co.	Mt. Vernon, N.Y.
64959	Western Electric Co., Inc.	New York, N.Y.
65092	Weston Inst. Inc. Weston-Newark	Newark, N.J.
66295	Wittek Mfg. Co.	Chicago, Ill.
66346	Minnesota Mining & Mfg. Co. Revere Mincom Div.	St. Paul, Minn.
70276	Allen Mfg. Co.	Hartford, Conn.
70309	Allied Control	New York, N.Y.
70318	Allmetal Screw Product Co., Inc.	Garden City, N.Y.
70417	Amplex, Div. of Chrysler Corp.	Detroit, Mich.
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.
70563	Amperite Co., Inc.	Union City, N.J.
70674	ADC Products Inc.	Minneapolis, Minn.
70903	Belden Mfg. Co.	Chicago, Ill.
70998	Bird Electronic Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N.Y.
71034	Bliley Electric Co., Inc.	Erie, Pa.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincy, Mass.
71218	Bud Radio, Inc.	Willoughby, Ohio
71279	Cambridge Thermionics Corp.	Cambridge, Mass.
71286	Camloc Fastener Corp.	Paramus, N.J.
71313	Cardwell Condenser Corp.	Lindenhurst L.I., N.Y.
71400	Bussmann Mfg. Div. of McGraw-Edison Co.	St. Louis, Mo.
71436	Chicago Condenser Corp.	Chicago, Ill.
71447	Calif. Spring Co., Inc.	Pico-Rivera, Calif.
71450	CTS Corp.	Elkhart, Ind.
71468	ITT Cannon Electric Inc.	Los Angeles, Calif.
71471	Cinema, Div. Aerovox Corp.	Burbank, Calif.
71482	C.P. Clare & Co.	Chicago, Ill.
71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
71616	Commercial Plastics Co.	Chicago, Ill.
71700	Cornish Wire Co., The	New York, N.Y.
71707	Coto Coil Co., Inc.	Providence, R.I.
71744	Chicago Miniature Lamp Works	Chicago, Ill.
71785	Cinch Mfg. Co., Howard B. Jones Div.	Chicago, Ill.
71984	Dow Corning Corp.	Midland, Mich.
72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.
72619	Dialight Corp.	Brooklyn, N.Y.
72656	Indiana General Corp., Electronics Div.	Keasby, N.J.
72699	General Instrument Corp., Cap. Div.	Newark, N.J.
72765	Drake Mfg. Co.	Harwood Heights, Ill.
72825	Hugh H. Eby Inc.	Philadelphia, Pa.
72928	Gudeman Co.	Chicago, Ill.
72962	Elastic Stop Nut Corp.	Union, N.J.
72964	Robert M. Hadley Co.	Los Angeles, Calif.
72982	Erie Technological Products, Inc.	Erie, Pa.
73061	Hansen Mfg. Co., Inc.	Princeton, Ind.
73076	H.M. Harper Co.	Chicago, Ill.
73138	Helipot Div. of Beckman Inst., Inc.	Fullerton, Calif.
73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Calif.
73445	Amperex Elect Co.	Hicksville, L.I., N.Y.
73506	Bradley Semiconductor Corp.	New Haven, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73586	Circle F Mfg. Co.	Trenton, N.J.
73682	George K. Garrett Co., Div. MSL Industries Inc.	Philadelphia, Pa.
73734	Federal Screw Products Inc.	Chicago, Ill.
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	General Industries Co., The	Elyria, Ohio
73846	Goshen Stamping & Tool Co.	Goshen, Ind.
73899	JFD Electronics Corp.	Brooklyn, N.Y.
73905	Jennings Radio Mfg. Corp.	San Jose, Calif.
73957	Groov-Pin Corp.	Ridgefield, N.J.
74276	Signalite Inc.	Neptune, N.J.
74455	J.H. Winns, and Sons	Winchester, Mass.
74861	Industrial Condenser Corp.	Chicago, Ill.
74868	R.F. Products Division of Amphenol-Borg Electronics Corp.	Danbury, Conn.
74970	E.F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75263	Keystone Carbon Co., Inc.	St. Marys, Pa.
75378	CTS Knights Inc.	Sandwich, Ill.
75382	Kulka Electric Corporation	Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.	Chicago, Ill.
75915	Littlefuse, Inc.	Des Plaines, Ill.
76005	Lord Mfg. Co.	Erie, Pa.
76210	C.W. Marwedel	San Francisco, Calif.
76433	General Instrument Corp., Micamold Division	Newark, N.J.
76487	James Millen Mfg. Co., Inc.	Malden, Mass.
76493	J.W. Miller Co.	Los Angeles, Calif.
76530	Cinch-Monadnock, Div. of United Carr Fastener Corp.	San Leandro, Calif.
76545	Mueller Electric Co.	Cleveland, Ohio
76703	National Union	Newark, N.J.
76854	Oak Manufacturing Co.	Crystal Lake, Ill.
77068	The Bendix Corp., Electrodynamics Div.	N. Hollywood, Calif.
77075	Pacific Metals Co.	San Francisco, Calif.
77221	Phanostran Instrument and Electronic Co.	South Pasadena, Calif.
77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.
77342	American Machine & Foundry Co. Potter & Brumfield Div.	Princeton, Ind.
77630	TRW Electronic Components Div.	Camden, N.J.
77638	General Instrument Corp., Rectifier Div.	Brooklyn, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.
77969	Rubbercraft Corp. of Calif.	Torrance, Calif.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
78277	Sigma	So. Braintree, Mass.
78283	Signal Indicator Corp.	New York, N.Y.
78290	Struthers-Dunn Inc.	Pitman, N.J.
78424	Speciality Leather Prod. Co.	Newark, N.J.
78452	Thompson-Bremer & Co.	Chicago, Ill.
78471	Tilley Mfg. Co.	San Francisco, Calif.
78488	Stackpole Carbon Co.	St. Marys, Pa.
78493	Standard Thomson Corp.	Waltham, Mass.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78790	Transformer Engineers	San Gabriel, Calif.
78947	Ucinite Co.	Newtonville, Mass.
79136	Waldes Kohinoor Inc.	Long Island City, N.Y.
79142	Veeder Root, Inc.	Hartford, Conn.
79251	Wenco Mfg. Co.	Chicago, Ill.
79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.
80031	Mepco Division of Sessions Clock Co.	Morristown, N.J.
80120	Schnitzer Alloy Products Co.	Elizabeth, N.J.
80131	Electronic Industries Association. Any brand Tube meeting EIA Standards-Washington, DC.	
80207	Unimax Switch, Div. Maxon Electronics Corp.	Wallingford, Conn.
80223	United Transformer Corp.	New York, N.Y.
80248	Oxford Electric Corp.	Chicago, Ill.
80294	Bourns Inc.	Riverside, Calif.
80411	Acro Div. of Robertshaw Controls Co.	Columbus, Ohio
80486	All Star Products Inc.	Defiance, Ohio
80509	Avery Label Co.	Monrovia, Calif.
80583	Hammarlund Co., Inc.	Mars Hill, N.C.
80640	Stevens, Arnold, Co., Inc.	Boston, Mass.
80813	Dimco Gray Co.	Dayton, Ohio
81030	International Instruments Inc.	Orange, Conn.
81073	Grayhill Co.	LaGrange, Ill.
81095	Triad Transformer Corp.	Venice, Calif.
81312	Winchester Elec. Div. Litton Ind., Inc.	Oakville, Conn.
81349	Military Specification	. . . . . .
81483	International Rectifier Corp.	El Segundo, Calif.
81541	Airpax Electronics, Inc.	Cambridge, Maryland
81860	Barry Controls, Div. Barry Wright Corp.	Watertown, Mass.
82042	Carter Precision Electric Co.	Skokie, Ill.
82047	Sperti Faraday Inc., Copper Hewitt Electric Div.	Hoboken, N.J.
82116	Electric Regulator Corp.	Norwalk, Conn.
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
82170	Fairchild Camera & Inst. Corp. Space & Defense System Div.	Paramus, N.J.
82209	Maguire Industries, Inc.	Greenwich, Conn.
82219	Sylvania Electric Prod. Inc. Electronic Tube Division	Emporium, Pa.
82376	Astron Corp.	East Newark, Harrison, N.J.
82389	Switchcraft, Inc.	Chicago, Ill.
82647	Metals & Controls Inc. Spencer Products	Attleboro, Mass.
82768	Phillips-Advance Control Co.	Joliet, Ill.
82866	Research Products Corp.	Madison, Wis.
82877	Rotron Mfg. Co., Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Calif.
83014	Hartwell Corp.	Los Angeles, Calif.
83058	Carr Fastener Co.	Cambridge, Mass.
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.
83125	General Instrument Corp., Capacitor Div.	Darlington, S.C.
83148	ITT Wire and Cable Div.	Los Angeles, Calif.
83186	Victory Eng. Corp.	Springfield, N.J.
83298	Bendix Corp., Red Bank Div.	Red Bank, N.J.
83315	Hubbell Corp.	Mundelein, Ill.
83324	Rosan Inc.	Newport Beach, Calif.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.
83332	Tech Labs	Palisade's Park, N.J.
83385	Central Screw Co.	Chicago, Ill.
83501	Gavitt Wire and Cable Co. Div. of Amerace Corp.	Brookfield, Mass.
83594	Burroughs Corp. Electronic Tube Div.	Plainfield, N.J.
83740	Union Carbide Corp. Consumer Prod. Div.	New York, N.Y.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.
83821	Loyd Scruggs Co.	Festus, Mo.
83942	Aeronautical Inst. & Radio Co.	Lodi, N.J.
84171	Arco Electronics Inc.	Great Neck, N.Y.
84396	A.J. Glesener Co., Inc.	San Francisco, Calif.
84411	TRW Capacitor Div.	Ogallala, Neb.
84970	Sarkes Tarzian, Inc.	Bloomington, Ind.
85454	Boonton Molding Company	Boonton, N.J.
85471	A.B. Boyd Co.	San Francisco, Calif.
85474	R.M. Bracamonte & Co.	San Francisco, Calif.

From: FSC. Handbook Supplements

CODE LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer	Address
85660	Koiled Kords, Inc.	Hamden, Conn.
85911	Seamless Rubber Co.	Chicago, Ill.
86174	Fafnir Bearing Co.	Los Angeles, Calif.
86197	Clifton Precision Products Co., Inc.	Clifton Heights, Pa.
86579	Precision Rubber Products Corp.	Dayton, Ohio
86684	Radio Corp. of America, Electronic Comp. & Devices Div.	Harrison, N.J.
86928	Seastrom Mfg. Co.	Glendale, Calif.
87034	Marco Industries	Anaheim, Calif.
87216	Philco Corporation (Lansdale Division)	Lansdale, Pa.
87473	Western Fibrous Glass Products Co.	San Francisco, Calif.
87664	Van Waters & Rogers Inc.	San Francisco, Calif.
87930	Tower Mfg. Corp.	Providence, R.I.
88140	Cutler-Hammer, Inc.	Lincoln, Ill.
88220	Gould-National Batteries, Inc.	St. Paul, Minn.
88698	General Mills, Inc.	Buffalo, N.Y.
89231	Graybar Electric Co.	Oakland, Calif.
89473	G. E. Distributing Corp.	Schenectady, N.Y.
89665	United Transformer Co.	Chicago, Ill.
90030	United Shoe Machinery Corp.	Beverly, Mass.
90179	US Rubber Co., Consumer Ind. & Plastics Prod. Div.	Passaic, N.J.
90970	Bearing Engineering Co.	San Francisco, Calif.
91146	ITT Cannon Elect, Inc., Salem Div.	Salem, Mass.
91260	Connor Spring Mfg. Co.	San Francisco, Calif.
91345	Miller Dial & Nameplate Co.	El Monte, Calif.
91418	Radio Materials Co.	Chicago, Ill.
91506	Augat Inc.	Attleboro, Mass.
91637	Dale Electronics, Inc.	Columbus, Nebr.
91662	Elco Corp.	Willow Grove, Pa.
91737	Gremar Mfg. Co., Inc.	Wakefield, Mass
91827	K F Development Co.	Redwood City, Calif.
91886	Malco Mfg. Co., inc.	Chicago, Ill.
91929	Honeywell Inc., Micro Switch Div.	Freeport, Ill.
91961	Nahm-Bros. Spring Co.	Oakland, Calif.
92180	Tru-Connector Corp.	Peabody, Mass.
92367	Elgeet Optical Co. Inc.	Rochester, N.Y.
92607	Tensolite Insulated Wire Co., Inc.	Tarrytown, N.Y.
92702	IMC Magnetics Corp.	Wesbury Long Island, N.Y.
92966	Hudson Lamp Co.	Kearney, N.J.
93332	Sylvania Electric Prod. Inc. Semiconductor Div.	Woburn, Mass.
93369	Robbins & Myers Inc.	Palisades Park, N.J.
93410	Stemco Controls, Div. of Essex Wire Corp.	Mansfield, Ohio
93632	Waters Mfg. Co.	Culver City, Calif.
93929	G.V. Controls	Livingston, N.J.
94137	General Cable Corp.	Bayonne, N.J.
94142	Phelps Dodge	Yonkers, N.Y.
94144	Raytheon Co., Comp. Div., Ind. Comp. Operations	Quincy, Mass.
94148	Scientific Electronics Products, Inc.	Loveland, Colo.
94154	Wagner Elect. Corp., Tung-Sol Div.	Newark, N.J.
94197	Curtiss-Wright Corp. Electronics Div.	East Paterson, N.J.
94222	South Chester Corp.	Chester, Pa.
94330	Wire Cloth Products, Inc.	Bellwood, Ill.
94375	Automatic Metal Products Co.	Brooklyn, N.Y.
94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.
94696	Magnecraft Electric Co.	Chicago, Ill.
95023	George A. Philbrick Researchers, Inc.	Boston, Mass.
95236	Allies Products Corp.,	Dania, Fla.
95238	Continental Connector Corp.	Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.	Long Island, N.Y.
95265	National Coil Co.	Sheridan, Wyo.
95275	Vitramon, Inc.	Bridgeport, Conn.
95348	Gordos Corp.	Bloomfield, N.J.
95354	Methode Mfg. Co.	Rolling Meadows, Ill.
95566	Arnold Engineering Co.	Marengo, Ill.
95712	Dage Electric Co., Inc.	Franklin, Ind.
95984	Siemon Mfg. Co.	Wayne, Ill.
95987	Weckesser Co.	Chicago, Ill.
96067	Microwave Assoc., West Inc.	Sunnyvale, Calif.
96095	Hi-Q Div. of Aerovox Corp.	Olean, N.Y.
96256	Thordarson-Meissner Inc.	Mt. Carmel, Ill.
96296	Solar Manufacturing Co.	Los Angeles, Calif.
96306	Microswitch, Div. of Minn.-Honeywell	Freeport, Ill.
96330	Carlton Screw Co.	Chicago, Ill.
96341	Microwave Associates, Inc.	Burlington, Mass.
96501	Excel Transformer Co.	Oakland, Calif.
96733	San Fernando Elect. Mfg. Co.	San Fernando, Calif.
96881	Thomson Ind. Inc.	Long Is., N.Y.
97464	Industrial Retaining Ring Co.	Irvington, N.J.
97539	Automatic & Precision Mfg.	Englewood, N.J.
97979	Reon Resistor Corp.	Yonkers, N.Y.
97983	Litton System Inc., Adler-Westrex Commun. Div.	New Rochelle, N.Y.
98141	R-Troncis, Inc.	Jamaica, N.Y.
98159	Rubber Teck, Inc.	Gardena, Calif.
98220	Hewlett-Packard Co., Moseley Div.	Pasadena, Calif.
98278	Microdot, Inc.	So. Pasadena, Calif.
98291	Sealectro Corp.	Mamaroneck, N.Y.
98376	Zero Mfg. Co.	Burbank, Calif
98410	Etc Inc.	Cleveland, Ohio
98731	General Mills Inc., Electronics Div.	Minneapolis, Minn.
98734	Paeco Div. of Hewlett-Packard Co.	Palo Alto, Calif.
98821	North Hills Electronics, Inc.	Glen Cove, N.Y.
98978	International Electronic Research Corp.	Burbank, Calif.
99109	Columbia Technical Corp.	New York, N.Y.
99313	Varian Associates	Palo Alto, Calif.
99378	Atlee Corp.	Winchester, Mass.
99515	Marshall Ind., Capacitor Div.	Monrovia, Calif.
99707	Control Switch Division, Controls Co. of America	El Segundo, Calif.
99800	Delevan Electronics Corp.	East Aurora, N.Y.
99848	Wilco Corporation	Indianapolis, Ind.
99928	Branson Corp.	Whippany, N.J.
99934	Renbrandt, Inc.	Boston, Mass.
99942	Hoffman Electronics Corp. Semiconductor Div.	El Monte, Calif.
99957	Technology Instrument Corp. of Calif.	Newbury Park, Calif.

THE FOLLOWING HP VENDORS HAVE NO NUMBER ASSIGNED IN THE LATEST SUPPLEMENT TO THE FEDERAL SUPPLY CODE FOR MANUFACTURERS HANDBOOK.

Code No.	Manufacturer	Address
0000F	Malco Tool and Die	Los Angeles, Calif.
0000Z	Willow Leather Products Corp.	Newark, N.J.
000AB	ETA	England
000BB	Precision Instrument Components Co.	Van Nuys, Calif.
000CS	Hewlett-Packard Co., Colorado Springs	Colorado Springs, Colorado
000MM	Rubber Eng. & Development	Hayward, Calif.
000NN	A "N" D Mfg. Co.	San Jose, Calif.
000QQ	Cooltron	Oakland, Calif.
000WW	California Eastern Lab.	Burlington, Calif.
000YY	S.K. Smith Co.	Los Angeles, Calif.

HEWLETT · PACKARD SALES AND SERVICE

UNITED STATES

ALABAMA
P.O. Box 4207
2003 Byrd Spring Road S.W.
Huntsville 35802
Tel: (205) 881-4591
TWX: 810-726-2204

ARIZONA
3009 North Scottsdale Road
Scottsdale 85251
Tel: (602) 945-7601
TWX: 910-950-1282

5737 East Broadway
Tucson 85716
Tel: (602) 298-2313
TWX: 910-952-1162

CALIFORNIA
1430 East Orangethorpe Ave.
Fullerton 92631
Tel: (714) 870-1000

3939 Lankershim Boulevard
North Hollywood 91604
Tel: (213) 877-1282
TWX: 910-499-2170

1101 Embarcadero Road
Palo Alto 94303
Tel: (415) 327-6500
TWX: 910-373-1280

2591 Carlsbad Avenue
Sacramento 95821
Tel: (916) 482-1463
TWX: 910-367-2092

1055 Shafter Street
San Diego 92106
Tel: (714) 223-8103
TWX: 910-335-2000

COLORADO
7965 East Prentice
Englewood 80110
Tel: (303) 771-3455
TWX: 910-935-0705

CONNECTICUT
508 Tolland Street
East Hartford 06108
Tel: (203) 289-9394
TWX: 710-425-3416

111 East Avenue
Norwalk 06851
Tel: (203) 853-1251
TWX: 710-468-3750

DELAWARE
3941 Kennett Pike
Wilmington 19807
Tel: (302) 655-6161
TWX: 510-666-2214

FLORIDA
P.O. Box 545
Suite 106
9999 N.E. 2nd Avenue
Miami Shores 33153
Tel: (305) 754-4565
TWX: 810-848-7262

P.O. Box 20007
Herndon Station 32814
621 Commonwealth Avenue
Orlando
Tel: (305) 841-3970
TWX: 810-850-0113

P.O. Box 8128
Madeira Beach 33708
410 150th Avenue
St. Petersburg
Tel: (813) 391-0211
TWX: 810-863-0366

GEORGIA
P.O. Box 28234
450 Interstate North
Atlanta 30328
Tel: (404) 436-6181
TWX: 810-766-4890

ILLINOIS
5500 Howard Street
Skokie 60076
Tel: (312) 677-0400
TWX: 910-223-3613

INDIANA
4002 Meadows Drive
Indianapolis 46205
Tel: (317) 546-4891
TWX: 810-341-3263

LOUISIANA
P.O. Box 856
1942 Williams Boulevard
Kenner 70062
Tel: (504) 721-6201
TWX: 810-955-5524

MARYLAND
6707 Whitestone Road
Baltimore 21207
Tel: (301) 944-5400
TWX: 710-862-0850

P.O. Box 1648
2 Choke Cherry Road
Rockville 20850
Tel: (301) 948-6370
TWX: 710-828-9684

MASSACHUSETTS
32 Hartwell Ave.
Lexington 02173
Tel: (617) 861-8960
TWX: 710-326-6904

MICHIGAN
24315 Northwestern Highway
Southfield 48075
Tel: (313) 353-9100
TWX: 810-232-1532

MINNESOTA
2459 University Avenue
St. Paul 55114
Tel: (612) 645-9461
TWX: 910-563-3734

MISSOURI
9208 Wyoming Place
Kansas City 64114
Tel: (816) 333-2445
TWX: 910-771-2087

2812 South Brentwood Blvd.
St. Louis 63144
Tel: (314) 962-5000
TWX: 910-760-1670

NEW JERSEY
W. 120 Century Road
Paramus 07652
Tel: (201) 265-5000
TWX: 710-990-4951

1060 N. Kings Highway
Cherry Hill 08034
Tel: (609) 667-4000
TWX: 710-892-4945

NEW MEXICO
P.O. Box 8366
Station C
6501 Lomas Boulevard N.E.
Albuquerque 87108
Tel: (505) 255-5586
TWX: 910-989-1665

156 Wyatt Drive
Las Cruces 88001
Tel: (505) 526-2485
TWX: 910-983-0550

NEW YORK
1702 Central Avenue
Albany 12205
Tel: (518) 869-8462
TWX: 710-441-8270

1219 Campville Road
Endicott 13764
Tel: (607) 754-0050
TWX: 510-252-0890

82 Washington Street
Poughkeepsie 12601
Tel: (914) 454-7330
TWX: 510-248-0012

39 Saginaw Drive
Rochester 14623
Tel: (716) 473-9500
TWX: 510-253-5981

1025 Northern Boulevard
Roslyn, Long Island 11576
Tel: (516) 869-8400
TWX: 510-223-0811

5858 East Molloy Road
Syracuse 13211
Tel: (315) 454-2486
TWX: 710-541-0482

NORTH CAROLINA
P.O. Box 5188
1923 North Main Street
High Point 27262
Tel: (919) 882-6873
TWX: 510-926-1516

OHIO
25575 Center Ridge Road
Cleveland 44145
Tel: (216) 835-0300
TWX: 810-427-9129

3460 South Dixie Drive
Dayton 45439
Tel: (513) 298-0351
TWX: 810-459-1925

OKLAHOMA
2919 United Founders Boulevard
Oklahoma City 73112
Tel: (405) 848-2801
TWX: 910-830-6862

OREGON
Westhills Mall, Suite 158
4475 S.W. Scholls Ferry Road
Portland 97225
Tel: (503) 292-9171
TWX: 910-464-6103

PENNSYLVANIA
2500 Moss Side Boulevard
Monroeville 15146
Tel: (412) 271-0724
TWX: 710-797-3650

1021 8th Avenue
King of Prussia Industrial Park
King of Prussia 19406
Tel: (215) 265-7000
TWX: 510-660-2670

RHODE ISLAND
873 Waterman Ave.
East Providence 02914
Tel: (401) 434-5535

TEXAS
P.O. Box 1270
201 E. Arapahoe Rd.
Richardson 75080
Tel: (214) 231-6101
TWX: 910-867-4723

P.O. Box 22813
4242 Richmond Avenue
Houston 77027
Tel: (713) 667-2407
TWX: 910-881-2645

GOVERNMENT CONTRACT OFFICE
225 Billy Mitchell Road
San Antonio 78226
Tel: (512) 434-4171
TWX: 910-871-1170

UTAH
2890 South Main Street
Salt Lake City 84115
Tel: (801) 486-8166
TWX: 910-925-5681

VIRGINIA
P.O. Box 6514
2111 Spencer Road
Richmond 23230
Tel: (703) 282-5451
TWX: 710-956-0157

WASHINGTON
433-108th N.E.
Bellevue 98004
Tel: (206) 454-3971
TWX: 910-443-2303

FOR U.S. AREAS NOT LISTED:
Contact the regional office nearest you: Atlanta, Georgia . . . North Hollywood, California . . . Paramus, New Jersey . . . Skokie, Illinois. Their complete addresses are listed above.

CANADA

ALBERTA
Hewlett-Packard (Canada) Ltd.
11745 Jasper Ave.
Edmonton
Tel: (403) 482-5561
TWX: 610-831-2431

BRITISH COLUMBIA
Hewlett-Packard (Canada) Ltd.
304-1037 West Broadway
Vancouver 9
Tel: (604) 738-5301
TWX: 610-922-5059

MANITOBA
Hewlett-Packard (Canada) Ltd.
511 Bradford Ct.
St. James
Tel: (204) 786-7581

NOVA SCOTIA
Hewlett-Packard (Canada) Ltd.
2745 Dutch Village Rd.
Suite 203
Halifax
Tel: (902) 455-0511
TWX: 610-271-4482

ONTARIO
Hewlett-Packard (Canada) Ltd.
880 Lady Ellen Place
Ottawa 3
Tel: (613) 722-4223
TWX: 610-562-1952

Hewlett-Packard (Canada) Ltd.
1415 Lawrence Avenue West
Toronto
Tel: (416) 249-9196
TWX: 610-492-2382

QUEBEC
Hewlett-Packard (Canada) Ltd.
275 Hymus Boulevard
Pointe Claire
Tel: (514) 697-4232
TWX: 610-422-3022
Telex: 01-20607

FOR CANADIAN AREAS NOT LISTED:
Contact Hewlett-Packard (Canada) Ltd. in Pointe Claire, at the complete address listed above.

CENTRAL AND SOUTH AMERICA

ARGENTINA
Hewlett-Packard Argentina S.A.C.e.I
Lavalle 1171 - 3°
Buenos Aires
Tel: 35-0436, 35-0627, 35-0431
Telex: 012-1009
Cable: HEWPACKARG

BRAZIL
Hewlett-Packard Do Brasil I.e.C Ltda.
Rua Coronel: Oscar Porto, 691
Sao Paulo - 8, SP
Tel: 71-1503
Cable: HEWPACK Sao Paulo

Hewlett-Packard Do Brasil I.e.C. Ltda.
Avenida Franklin Roosevelt 84-grupo 203
Rio de Janeiro, ZC-39, GB
Tel: 32-9733
Cable: HEWPACK Rio de Janeiro

CHILE
Hector Calcagni P.
Casilla 13942
Estado 215 - Oficina 1016
Santiago
Tel: 31-890, 490-505

COLOMBIA
Instrumentacion
Henrik A. Langebaek & Kier Ltda.
Carrera 7 #48-59
Apartado Aereo 6287
Bogota, 1 D.E.
Tel: 45-78-06, 45-55-46
Cable: AARIS Bogota

COSTA RICA
Lic. Alfredo Gallegos Gurdián
Apartado 3243
San José
Tel: 21-86-13
Cable: GALGUR San José

ECUADOR
Laboratorios de Radio-Ingenieria
Calle Guayaquil 1246
Post Office Box 3199
Quito
Tel: 12496
Cable: HORVATH Quito

EL SALVADOR
Electrónica
Apartado Postal 1589
27 Avenida Norte 1133
San Salvador
Tel: 25-74-50
Cable: ELECTRONICA San Salvador

GUATEMALA
Olander Associates Latin America
Apartado 1226
7a. Calle, 0-22, Zona 1
Guatemala City
Tel: 22812
Cable: OLALA Guatemala City

MEXICO
Hewlett-Packard Mexicana, S.A. de C.V.
Moras 439
Col. del Valle
Mexico 12, D.F.
Tel: 75-46-49

NICARAGUA
Roberto Terán G.
Apartado Postal 689
Edificio Terán
Managua
Tel: 3451, 3452
Cable: ROTERAN Managua

PANAMA
Electrónica Balboa, S.A.
P.O. Box 4929
Ave. Manuel Espinosa No. 13-50
Bldg. Alina
Panama City
Tel: 30833
Cable: ELECTRON Panama City

PERU
Fernando Ezeta B.
Avenida Petit Thouars 4719
Miraflores
Casilla 3061
Lima
Tel: 50346
Cable: FEPERU Lima

PUERTO RICO
San Juan Electronics, Inc.
P.O. Box 5167
Ponce de Leon 154
Pda. 3-Pta. de Tierra
Tel: (809) 725-3342
Cable: SATRONICS San Juan
Telex: SATRON 3450 332

URUGUAY
Pablo Ferrando S.A.
Comercial e Industrial
Avenida Italia 2877
Casilla de Correo 370
Montevideo
Tel: 40-3102
Cable: RADIUM Montevideo

VENEZUELA
Hewlett-Packard De Venezuela C.A.
Apartado del Este 10934
Chacaito
Caracas
Tel: 71.88.05, 71.88.69, 71.88.76
Cable: HEWPACK Caracas

FOR AREAS NOT LISTED, CONTACT:
Hewlett-Packard Inter-Americas
3200 Hillview Ave.
Palo Alto, California 94304
Tel: (415) 326-7000
TWX: 910-373-1267
Cable: HEWPACK Palo Alto
Telex: 034-8461

HEWLETT • PACKARD SALES AND SERVICE

EUROPE

AUSTRIA
Unilabor GmbH
Wissenschaftliche Instrumente
Rummelhardtgasse 6/3
P.O. Box 33
Vienna A-1095
Tel: 42 61 81
Cable: LABORINSTRUMENT Vienna
Telex: 75 762

BELGIUM
Hewlett-Packard Benelux S.A.
348 Boulevard du Souverain
Brussels 16
Tel: 72 22 40
Cable: PALOBEN Brussels
Telex: 23 494

DENMARK
Hewlett-Packard A/S
Langebjerg 6
2850 **Naerum**
Tel: (01) 80 40 40
Cable: HEWPACK AS
Telex: 66 40

FINLAND
Hewlett-Packard Oy
Gyldenintie 3
Helsinki 20
Tel: 67 35 38
Cable: HEWPACKOY-Helsinki
Telex: 12-1563

FRANCE
Hewlett-Packard France
Quartier de Courtaboeuf
Boite Postale No. 6
91 Orsay
Tel: 920 88 01
Cable: HEWPACK Orsay
Telex: 60048 HEWPACK ORSAY

Hewlett-Packard France
4 Quai des Etroits
69 **Lyon** 5e
Tel: 42 63 45
Cable: HEWPACK Lyon
Telex: 31617

GERMANY
Hewlett-Packard Vertriebs-GmbH
Lietzenburgerstrasse 30
1 **Berlin W** 30
Tel: 24 60 65/66
Telex: 18 34 05

Hewlett-Packard Vertriebs-GmbH
Herrenbergerstrasse 110
703 **Böblingen, Württemberg**
Tel: 07031-6671
Cable: HEPAG Böblingen
Telex: 72 65 739

Hewlett-Packard Vertriebs-GmbH
Achenbachstrasse 15
4 **Düsseldorf** 1
Tel: 68 52 58/59
Telex: 85 86 533

Hewlett-Packard Vertriebs-GmbH
Kurhessenstrasse 95
6 **Frankfurt** 50
Tel: 52 00 36
Cable: HEWPACKSA Frankfurt
Telex: 41 32 49

Hewlett-Packard Vertriebs-GmbH
Beim Strohhause 26
2 **Hamburg** 1
Tel: 24 05 51/52
Cable: HEWPACKSA Hamburg
Telex: 21 53 32

Hewlett-Packard Vertriebs-GmbH
Reginfriedstrasse 13
8 **München** 9
Tel: 0811 69 59 71/75
Cable: HEWPACKSA München
Telex: 52 49 85

GREECE
Kostas Karayannis
18, Ermou Street
Athens 126
Tel: 230 301
Cable: RAKAR Athens
Telex: 21 59 62

IRELAND
Hewlett-Packard Ltd.
224 Bath Road
Slough, Bucks, England
Tel: Slough 753-33341
Cable: HEWPIE Slough
Telex: 84413

ITALY
Hewlett-Packard Italiana S.p.A.
Viale Lunigiana 46
20125 **Milan**
Tel: 69 15 84
Cable: HEWPACKIT Milan
Telex: 32046

Hewlett-Packard Italiana S.p.A.
Palazzo Italia
Piazza Marconi 25
00144 **Rome** - Eur
Tel: 591 2544
Cable: HEWPACKIT Rome
Telex: 61514

NETHERLANDS
Hewlett-Packard Benelux, N.V.
Weederstein 117
Amsterdam, Z 11
Tel: 42 77 77
Cable: PALOBEN Amsterdam
Telex: 13 216

NORWAY
Hewlett-Packard Norge A/S
Box 149
Nesveien 13
Haslum
Tel: 53 83 60
Cable: HEWPACK Oslo
Telex: 6621

PORTUGAL
Telectra
Rua Rodrigo da Fonseca 103
P.O. Box 2531
Lisbon 1
Tel: 68 60 72
Cable: TELECTRA Lisbon
Telex: 1598

SPAIN
Ataio Ingenieros
Ganduxer 76
Barcelona 6
Tel: 211-44-66

Ataio Ingenieros
Enrique Larreta 12
Madrid, 16
Tel: 235 43 44
Cable: TELEATAIO Madrid
Telex: 2 72 49

SWEDEN
Hewlett-Packard (Sverige) AB
Hagakersgatan 9C
431 04 **Mölndal** 4
Tel: 031 - 27 68 00

Hewlett-Packard (Sverige) AB
Svetsarvägen 7
S171 20 **Solna** 1
Tel: (08) 98 12 50
Cable: MEASUREMENTS Stockholm
Telex: 10721

SWITZERLAND
Hewlett Packard (Schweitz) AG
Zurcherstrasse 20
8952 Schlieren
Zurich
Tel: (051) 98 18 21/24
Cable: HEWPACKAG Zurich
Telex: 53933

Hewlett Packard (Schweitz) A.G.
Rue du Bois-du-Lan 7
1217 **Meyrin-Geneva**
Tel: (022) 41 54 00
Cable: HEWPACKSA Geneva
Telex: 2 24 86

TURKEY
Telekom Engineering Bureau
P.O. Box 376 - Galata
Istanbul
Tel: 49 40 40
Cable: TELEMATION Istanbul

UNITED KINGDOM
Hewlett-Packard Ltd.
224 Bath Road
Slough, Bucks
Tel: Slough 753-33341
Cable: HEWPIE Slough
Telex: 84413

YUGOSLAVIA
Belram S.A.
83 avenue des Mimosas
Brussels 15, Belgium
Tel: 34 33 32, 34 26 19
Cable: BELRAMEL Brussels
Telex: 21790

FOR AREAS NOT LISTED, CONTACT:
Hewlett-Packard S.A.
Rue du Bois-du-Lan 7
1217 **Meyrin-Geneva**
Tel: (022) 41 54 00
Cable: HEWPACKSA Geneva
Telex: 2.24.86

AFRICA, ASIA, AUSTRALIA

ANGOLA
Telectra Empresa Técnica de Equipamentos Eléctricos SAR
Rua de Barbosa Rodrigues 42-1°
Box 6487
Luanda
Cable: TELECTRA Luanda

AUSTRALIA
Hewlett-Packard Australia Pty. Ltd.
22-26 Weir Street
Glen Iris, 3146
Victoria
Tel: 20.1371 (4 lines)
Cable: HEWPARD Melbourne
Telex: 31024

Hewlett-Packard Australia Pty. Ltd.
61 Alexander Street
Crows Nest 2065
New South Wales
Tel: 43.7866
Cable: HEWPARD Sydney

Hewlett-Packard Australia Pty. Ltd.
97 Churchill Road
Prospect 5082
South Australia
Tel: 65.2366
Cable: HEWPARD Adelaide

Hewlett Packard Australia Pty. Ltd.
2nd Floor, Suite 13
Casablanca Buildings
196 Adelaide Terrace
Perth, W.A. 6000

CEYLON
United Electricals Ltd.
P.O. Box 681
Yahala Building
Staples Street
Colombo 2
Tel: 5496
Cable: HOTPOINT Colombo

CYPRUS
Kypronics
19-19D Hommer Avenue
P.O. Box 752
Nicosia
Tel: 6282-75628
Cable: HE-I-NAMI

ETHIOPIA
African Salespower & Agency Private Ltd., Co.
P. O. Box 718
58/59 Cunningham St.
Addis Ababa
Tel: 12285
Cable: ASACO Addisababa

HONG KONG
Schmidt & Co. (Hong Kong) Ltd.
P.O. Box 297
1511, Prince's Building
10, Chater Road
Hong Kong
Tel: 240168, 232735
Cable: SCHMIDTCO Hong Kong

INDIA
The Scientific Instrument Co., Ld.
6, Tej Bahadur Sapru Road
Allahabad 1
Tel: 2451
Cable: SICO Allahbad

The Scientific Instrument Co., Ld.
240, Dr. Dadabhai Naoroji Road
Bombay 1
Tel: 26-2642
Cable: SICO Bombay

The Scientific Instrument Co., Ld.
11, Esplanade East
Calcutta 1
Tel: 23-4129
Cable: SICO Calcutta

The Scientific Instrument Co., Ld.
30, Mount Road
Madras 2
Tel: 86339
Cable: SICO Madras

The Scientific Instrument Co. Ltd.
5-8-525 Mahatma Gandhi Road
Hyderabad-1 (A-P) India
Cable: SICO Hyderabad

The Scientific Instrument Co., Ld.
B-7, Ajmeri Gate Extn.
New Delhi 1
Tel: 27-1053
Cable: SICO New Delhi

INDONESIA
Bah Bolon Trading Coy. N.V.
Djalah Merdeka 29
Bandung

IRAN
Telecom, Ltd.
P. O. Box 1812
240 Kh. Saba Shomali
Teheran
Tel: 43850, 48111
Cable: BASCOM Teheran

ISRAEL
Electronics & Engineering Div. of Motorola Israel Ltd.
16, Kremenetski Street
Tel-Aviv
Tel: 35021 (4 lines)
Cable: BASTEL Tel-Aviv
Telex: Bastel Tv 033-569

JAPAN
Yokogawa-Hewlett-Packard Ltd.
Nisei Ibaragi Bldg.
2-2-8 Kasuga
Ibaragi-Shi
Osaka
Tel: 23-1641

Yokogawa-Hewlett-Packard Ltd.
Ito Building
No. 59, Kotori-cho
Nakamura-ku, **Nagoya City**
Tel: 551-0215

Yokogawa-Hewlett-Packard Ltd.
Ohashi Building
59 Yoyogi 1-chrome
Shibuya-ku, **Tokyo**
Tel: 370-2281
Telex: 232-2024YHP
Cable: YHPMARKET TOK 23-724

KENYA
R. J. Tilbury Ltd.
P. O. Box 2754
Suite 517/518
Hotel Ambassadeur
Nairobi
Tel: 25670, 26803, 68206, 58196
Cable: ARJAYTEE Nairobi

KOREA
American Trading Co., Korea, Ltd.
P.O. Box 1103
Dae Kyung Bldg.
107 Sejong Ro
Chongro Ku
Seoul
Tel: 75-5841 (4 lines)
Cable: AMTRACO Seoul

LEBANON
Constantin E. Macridis
Clemenceau Street
Clemenceau Center
Beirut
Tel: 220846
Cable: ELECTRONUCLEAR Beirut

MALAYSIA
MECOMB Malaysia Ltd.
2 Lorong 13/6A
Section 13
Petaling Jaya, **Selangor**
Cable: MECOMB Kuala Lumpur

MOZAMBIQUE
A. N. Goncalves, LDA.
4.1 Apt. 14 Av. D. Luis
P.O. Box 107
Lourenco Marques
Cable: NEGON

NEW ZEALAND
Hewlett-Packard (N.Z.) Ltd.
32-34 Kent Terrace
P.O. Box 9443
Wellington, N.Z.
Tel: 56-409
Cable: HEWPACK Wellington

PAKISTAN (EAST)
Mushko & Company, Ltd.
31, Jinnah Avenue
Dacca
Tel: 80058
Cable: NEWDEAL Dacca

PAKISTAN (WEST)
Mushko & Company, Ltd.
Oosman Chambers
Victoria Road
Karachi 3
Tel: 51027, 52927
Cable: COOPERATOR Karachi

PHILIPPINES
Electromex Inc.
2129 Pasong Tamo
Makati, Rizal
P.O. Box 4326
Manila
Tel: 88-91-71 or 88-83-76
Cable: ELEMEX Manila

SINGAPORE
Mechanical and Combustion Engineering Company Ltd.
9, Jalan Kilang
Singapore, 3
Tel: 642361-3
Cable: MECOMB Singapore

SOUTH AFRICA
Hewlett Packard South Africa (Pty.), Ltd.
Hill House
43 Somerset Rd.
Cape Town
Tel: 3-6019
Cable: HEWPACK Cape Town
Telex: 7038CT

Hewlett Packard South Africa (Pty.), Ltd.
P.O. Box 31716
30 De Beer Street
Braamfontein, **Johannesburg**
Tel: 724-4172 724-4195
Telex: 0226 JH
Cable: HEWPACK Johannesburg

TAIWAN
Hwa Sheng Electronic Co., Ltd.
P. O. Box 1558
Room 404
Chia Hsin Building
No. 96 Chung Shan North Road, Sec. 2
Taipei
Tel: 555211 Ext. 532-539
Cable: VICTRONIX Taipei

TANZANIA
R. J. Tilbury Ltd.
P.O. Box 2754
Suite 517/518
Hotel Ambassadeur
Nairobi
Tel: 25670, 26803, 68206, 58196
Cable: ARJAYTEE Nairobi

THAILAND
The International Engineering Co., Ltd.
P. O. Box 39
614 Sukhumvit Road
Bangkok
Tel: 910722 (7 lines)
Cable: GYSOM Bangkok

UGANDA
R. J. Tilbury Ltd.
P.O. Box 2754
Suite 517/518
Hotel Ambassadeur
Nairobi
Tel: 25670, 26803, 68206, 58196
Cable: ARJAYTEE Nairobi

VIETNAM
Peninsular Trading Inc.
P.O. Box H-3
216 Hien-Vuong
Saigon
Tel: 20.805
Cable: PENINSULA Saigon

ZAMBIA
R. J. Tilbury (Zambia) Ltd.
P.O. Box 2792
Lusaka
Zambia, Central Africa

FOR AREAS NOT LISTED, CONTACT:
Hewlett-Packard Export Marketing
3200 Hillview Ave.
Palo Alto, California 94304
Tel: (415) 326-7000
TWX: 910-373-1267
Cable: HEWPACK Palo Alto
Telex: 034-8461

Printed in U.S.A. 30M-11/68

E 6/69

MANUAL BACKDATING CHANGES

MODEL 3430A

DIGITAL VOLTMETER

Manual Serial Prefixed: 943-
-hp- Part No. 03430-90002

This manual backdating sheet makes this manual applicable to earlier instruments. Instrument-component values that differ from those in the manual, yet are not listed in the backdating sheet, should be replaced using the part number given in the manual.

Instrument Serial Prefix	Make Manual Changes	Instrument Serial Prefix	Make Manual Changes
749-02550 and below	CHANGE #1		

CHANGE 1: Page 5-5, Paragraph 5-21:

Replace INVERTER AMPLIFIER ADJUSTMENTS with the following procedure:

5-21. POLARITY AND INVERTER AMPLIFIER ADJUSTMENTS.

a. Connect dc standard to 3430A INPUT. With the 3430A RANGE switch on 100 mV, adjust the dc standard output to -99.0 mV.

b. Short A1TP1 to A1TP5 ( ). This shorts the inverter amplifier and polarity amplifier inputs.

c. Slowly adjust A1R59 so that + and - indicators on front panel just change from - to +. This zeros the polarity amplifier.

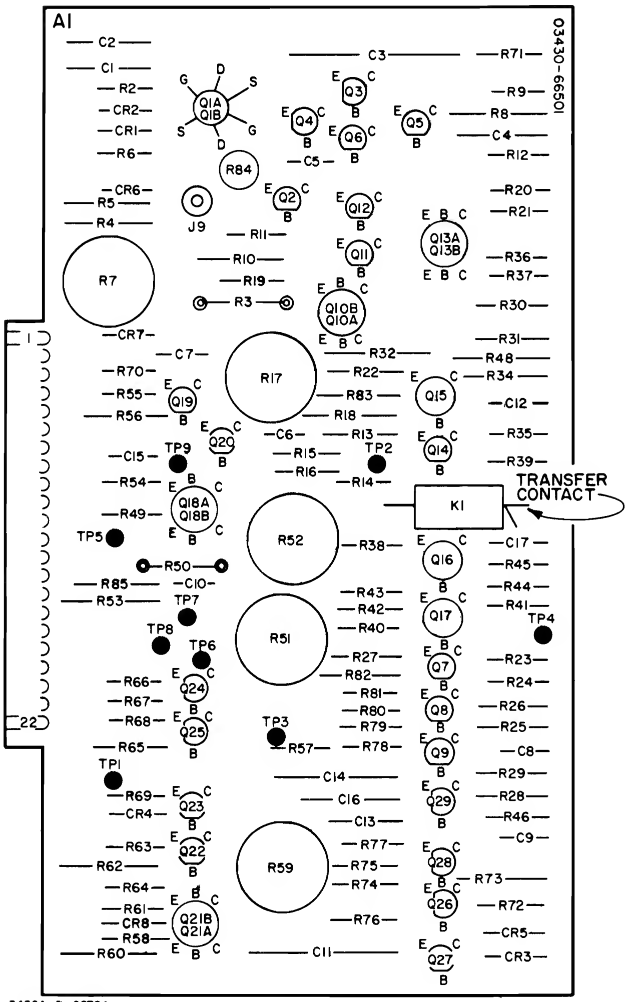
d. Connect the dc differential voltmeter to the amplifier output at A1TP2.

e. Adjust A1R17 for a 0.0 V ±0.25 mV indication on the differential voltmeter.

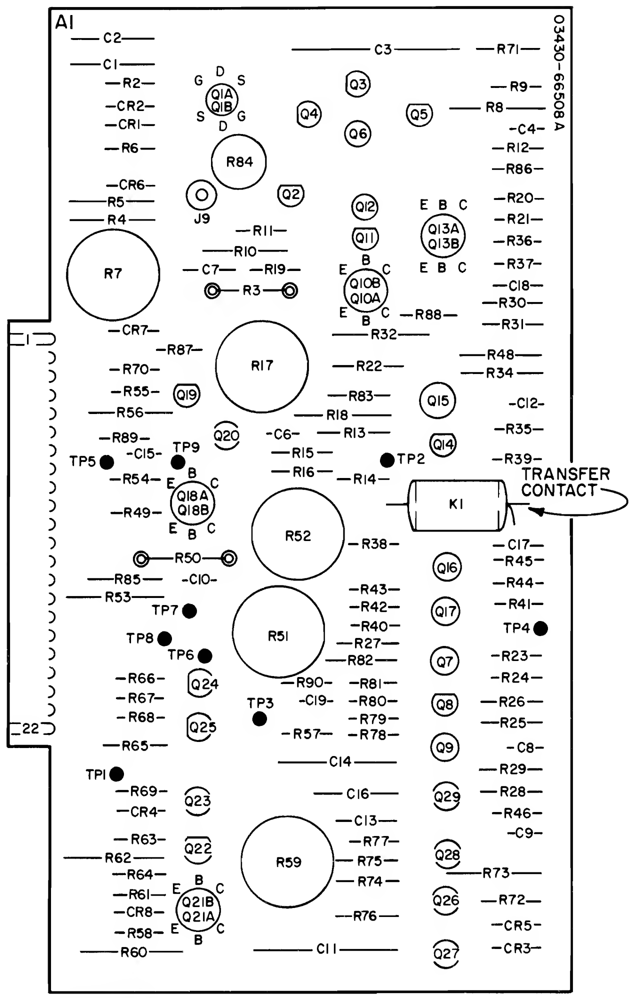
f. Remove the short from A1TP1 to A1TP5.

Page 7-5/7-6, Figure 7-3:

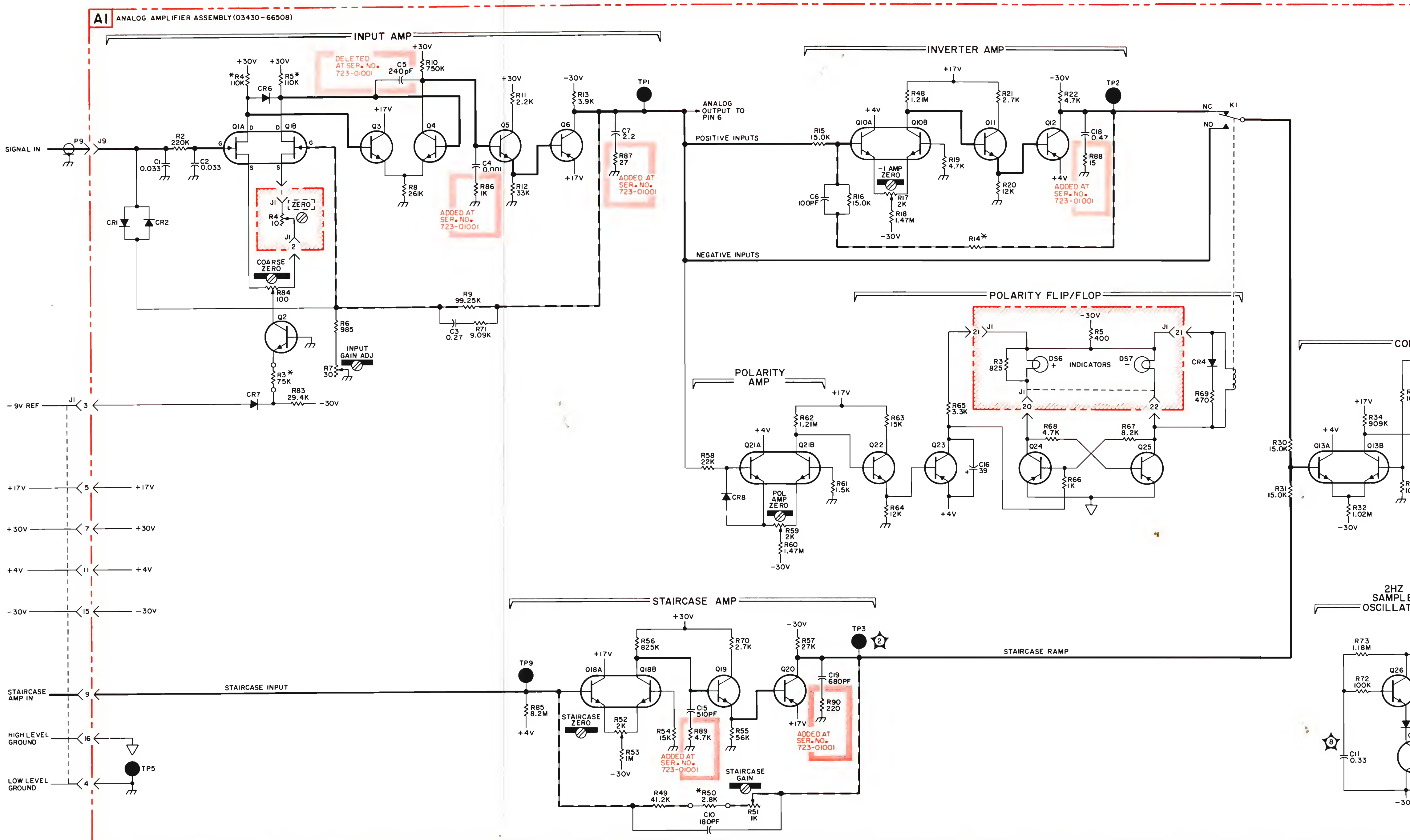
Replace Schematic Diagram, A1 Amplifier Assembly with the following schematic. This diagram applies to both part number 03430-66508 and 03430-66501.



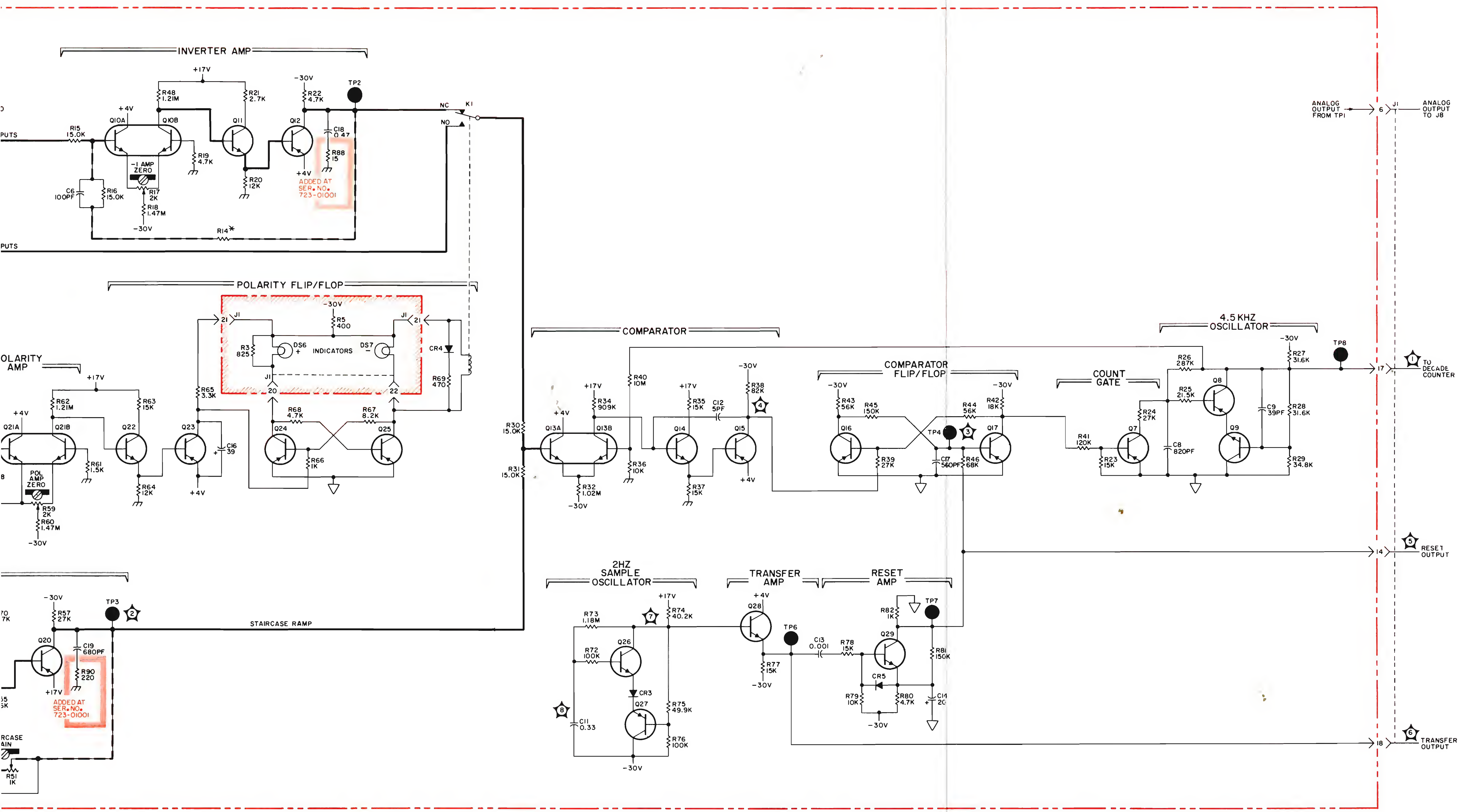
3430A-B-0879A



3430A-B-30094



3430A-E-30100A



NOTE THIS SCHEMATIC APPLIES TO INSTRUMENTS SER. NO. 749-02550 AND BELOW

MANUAL CHANGES

MODEL 3430 A

DIGITAL VOLTMETER

Manual Serial Prefixed: 943
Manual Printed: SEPT. 1969

To adapt this manual to instruments with other serial prefixes check for errata below, and make changes shown in tables.

Instrument Serial Prefixes		Make Manual Changes
G-929-	and above	1
G-971-	and above	1 - 2
1050G	and above	1 - 3

ERRATA: Page 1-0, Table 1-1, Specification:
"Zero stability is better than 25 uV/°C" should read:
"Zero stability is better than .25 uV/°C on 100 mV range".

			-hp- Stock No.
	In Section VI, Replaceable Parts and pertaining Schematics:		
Change:	A2DS1A thru DS1H, A3DS1A thru DS1H, A4DS1A thru DS1H	Lamp - Glow to	2140-0044
	A3C4	C:fxd., dipped Mica to 140 pF, ± 2%	0140-0217
Add:	F1	Fuse - Cartridge 0.15 Ampere (for 230V Oper.)	2110-0320
	Under Miscellaneous:		
Change:	MP25	Cord - set, power to (For instruments equipped with German "Schuko" Power - Cord only)	8120-0100
	A1Q20,24	Transistor - Si PNP to 2N 3906	1853-0036
	A2DS2, A3DS2, A4DS2	to Indicator - Tube - Nixie	1970-0041
	A2Q1 thru Q8, Q20, Q21, A3Q1 thru Q8, A4Q1 thru Q8	to Transistor selected	5080-0060
	A2S1	Switch slide to	3101-0982
Add:	A3CR13/A4CR13	Diode : Ge	1910-0016
	Add on Schematic Diagram 7-9/7-10 and 7-11/7-12 Diodes are connected between the connection of	C13/R22 and + 4V.	
Change:	R1	R:fxd., comp. 39 K, ± 10%, 1/2W	0687-3931
	R5	to R:fxd., 470 Ohm, 2W	0698-3634

Nov. 30, 1970

MODEL 3430A

CHANGE 1: Add to description of A1 Assembly : Amplifier 03430-66511 "Used in serial number 933-02551 and higher and G-929-00426 and higher.

CHANGE 2:

			-hp- Stock No.
Change:	MP25	Power Cord to	8120-1349
	MP24	Connector Power to	1251-2357
		Panel Rear to	03430-00203
	S2	Switch Toggle to	3101-1103
	S3	Switch Slide to	3101-1234
	A1Q25	Transistor NPN to	1853-0090
	F1	Fuse .125 A (115V Oper.)	2110-0318

CHANGE 3:

Change:	S1	Switch rotary to	3100-2711
		Panel Front to	03430-00204
Add:		Bushing	1410-0110
		Insulator Switch	4040-0775

Change Ground Symbols from to

HEWLETT hp PACKARD

03430-90002

PRINTED IN U.S.A.